TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

SECRETARY AND TREASURER,

WILLIAM J. MOFFAT,

FELLOW OF THE BOTANICAL SOCIETY, EDINBURGH.

VOL. XIII.

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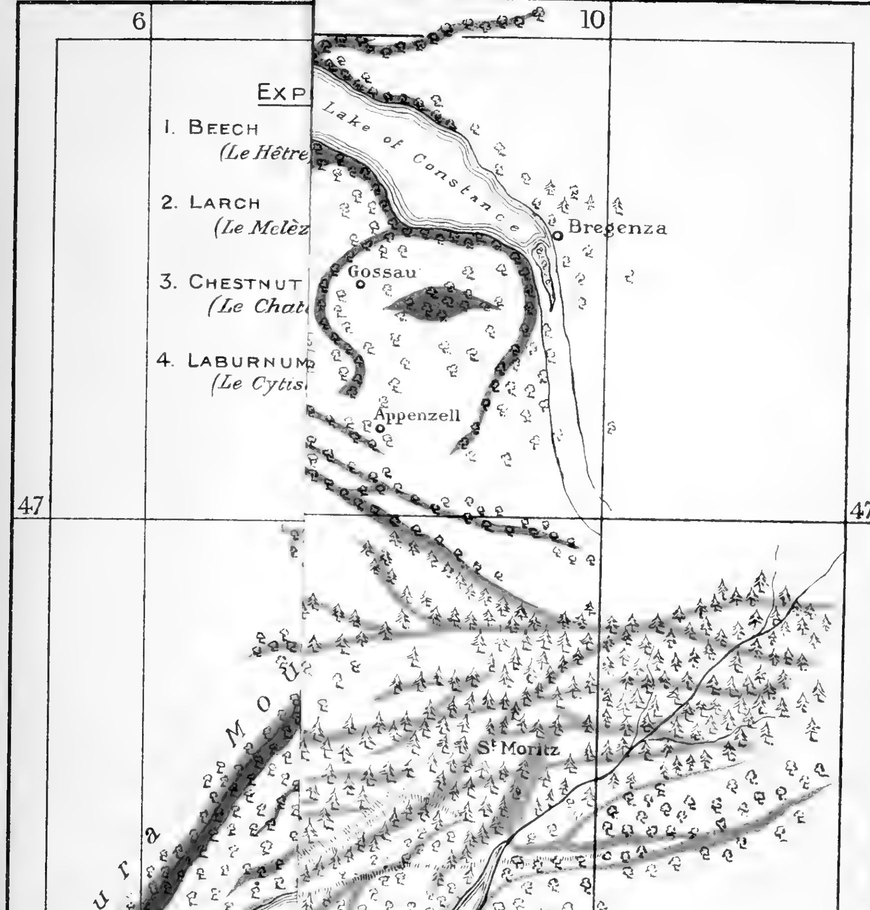
CONTENTS OF VOL. XIII.

The Society, as a body, is not to be considered responsible for any statements or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

APPENDIX TO PART II.



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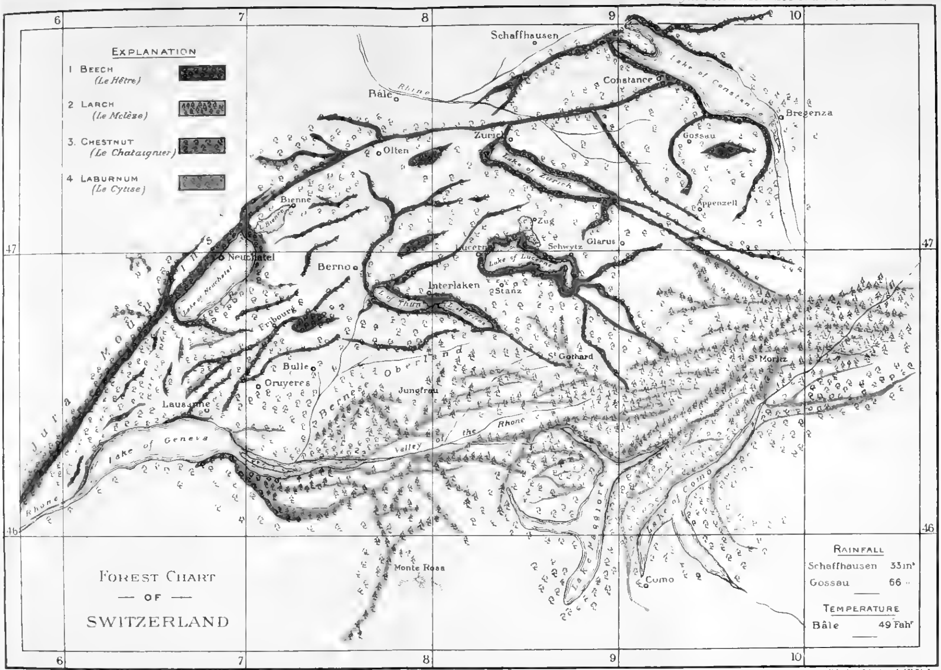

FOREST CHART — OF — SWITZERLAND

Notabilia. (1) The BEECH dominates in the Jura at a height of from 1300 to 1800 feet, there forming a continuous chain.

(2) The LARCH occupies the Central Alps, avoiding the Jura altogether.

(3) The CHESTNUT grows freely in the Southern Alps, and on borders of lakes to North of Alps.

For the OAK we must go to the South, and for the SCOTS PINE to the North—Darmstadt, &c.

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OF THE

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VOL. XIII.—PART I.

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TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

I. *Address delivered at the Thirty-seventh Annual Meeting, 5th August* 1890. By Mr D. F. Mackenzie, Morton Hall, Vice-President.

Gentlemen,—In the absence of the President of our Society, I am called on to make the customary Address from the Chair, and I think I cannot make a better use of the opportunity than to draw your attention for a short time to the large extent of what is called "Waste Land" in Scotland, and the amount of the same which could be profitably devoted to the growth of Forest Trees.

Scotland is very irregular in outline, being so broken up by promontories stretching far into the sea, and by arms of the sea deeply indenting the land, that a great portion of the interior lies within less than forty miles from the sea. This accounts, to a large extent, for the difficulty in getting timber to grow at such high altitudes as it often does on the Continent. The superficial area, according to the Board of Trade, is computed to be 30,463 square miles, or 19,496,133 statute acres; but the final results of the Ordnance Survey give the figures at 19,777,490 acres of land and water. The latter includes lakes, rivers, rivulets, and permanent pools down to the horse-pond. It also includes land or beaches along the seaboard, and estuaries to low-water mark. Such are the details laid down by the Ordnance Survey Department, from whose works, and the Board of Trade Returns, the figures I am about to submit to you have been taken; but, for the sake of saving time, I adopt those of the Board of Trade for the cultivated areas, and the Ordnance Survey for the other details.

In order to find the total area suitable and available for the profitable growing of timber, we have to deduct the area under crops of all kinds, woodlands, gardens, nurseries, towns, villages, houses, railways, roads, and water, as also those portions of our glens and mountain sides that are profitably grazed by sheep and deer. This done, we will have found the actual area of waste land; I mean waste in comparison to what it might be if suitably employed. From this area we must deduct all high-lying exposed parts of our hills and mountains, quite unsuitable for the profitable growing, or even the growth, of any kind of timber. This latter is regulated not so much by the height as by the distance inland, and the position of the mountain ranges, whether lying across the track of the prevailing winds of the district or along their path. Very good examples of this fact are to be met with at Rothiemurchus, Abernethy, Duthil, and Braemar, where the pine is to be found flourishing at an altitude of over 2000 feet above sea-level; and also in a large track of country in the county of Aberdeen, from near Huntly to Alford. Many more instances could be mentioned to illustrate this point, but enough has been given for our purpose.

I now come to the figures. As already stated, the total area of Scotland is computed to be 19,496,133 acres imperial, of which, according to the Board of Trade Returns, Ordnance Survey, etc., 4,739,000 acres are under crops of all kinds, including grass; under woods, 830,000 acres; and gardens, orchards, and nurseries, 6920 acres; while towns, houses, roads, railways, paths, and walls take up 1,093,300 acres; water, lakes, rivers, etc., 1,026,337 acres; and 1,260,021 acres are profitably grazed by sheep and deer; thus leaving 10,540,855 acres to be accounted for as semi-waste land. Of this latter area a large portion falls to be deducted as of no value for growing any kind of timber, viz., that portion of our island directly exposed to the storms from the Atlantic and North Sea, and the tops of mountains too high and exposed for the growth of timber. This portion alone takes up 1,950,000 acres or thereby, including in its area all the highest slopes of our northern and eastern seaboard, leaving 8,590,855 acres or thereby worth less, at the present moment, than 2s. per imperial acre. But we have here again to make a rather curious but important deduction, viz., those roads and strips of waste so very common in the Highlands and elsewhere, too small of themselves to be profitably planted, but which are included in the Ordnance Survey measurements, and not given separately. I calculate the area of these to be, say, 146,322 acres. I may state that these latter figures are approximate, but are calculated on the basis of that found on given areas. Assuming these figures to be nearly correct, we are left with the still large surface of 8,444,533 acres highly suitable for the profitable production of first-class pine and other timber. This, then, proves so far the great loss we, as a nation, have sustained, are still sustaining, and are likely to sustain for a time, by not appropriating to our advantage the waste lands of our own country.

The term *waste* land is perhaps a misnomer, as land can only be said to be waste by comparison with what its value might be under other and different circumstances and management—management more profitable to both the owners and the nation at large. There are few countries of the same population to a given area which have so large a proportion of their surface comparatively waste or "idle," and so small a proportion of growing woods to the unit of population. This, no doubt, arises from the fact of our having an abundant supply of coal—wood for fuel being at a discount—and that there are no State forests or public interest in forestry. The public, as a whole, admire trees merely for their fine effect in the landscape, or the pleasant green of their foliage, and the shelter and shade they give in street, park, or highway—forgetting all the while, or not knowing or caring to know, the immense influence for good trees have on their welfare generally, and particularly by their sanitary influence, their extraordinary power of ameliorating a rigid and changeful climate, and regulating storms, thereby greatly prolonging life itself; whilst, looking at the case from a commercial point of view, nothing is more certain than if the area of our woodlands were increased even fourfold, the fertility of the remaining portion of waste would be so increased as to be able to support a much larger amount of live stock, and would give better crops and earlier harvests than at present. This is well understood in the district in which our meeting is being held—Easter Ross—as well as many other districts of Scotland, especially in the counties of Inverness, Aberdeen, Forfar, Perth, Berwick, and Roxburgh. Many parts of these counties are well wooded, not merely by large areas, but by the judicious arrangements of clumps, belts, etc. (we will see very good examples of this on the Fairburn estates), rendering valuable shelter to stock, thereby increasing the bulk of produce in a given time by about 30 per cent. This is already so well known, that further example or reference is not required here.

Apart from this view of the case, however, the increased area of woodland would give necessarily a large increase of work to that class—the crofters—who most require it, and who, as a rule, reside in the districts where such operations require to be most extensively carried out. Such increase would be of great advantage to the public at large, to the proprietors of the land, and to posterity—to the latter by retaining a large amount of the money sent out of the country to purchase that which we could produce for ourselves, and in many cases of a superior quality to that imported as "seconds" and "thirds," the latter of which forms the greater bulk of our timber imports; and if you plant the 8,000,000 acres you find employment for 40,000 individuals.

In conclusion, it may be observed that the areas are dealt with, in the Returns of the Board of Trade and by the Ordnance Survey, in such a manner as to fully account for every acre under its different heading, with the exception of those parts of the Ross-shire, Inverness, and Perthshire Highlands where sheep are allowed to roam at large on the most barren portions of the mountains. This is not only a loss to the stockmaster, but to the country, because, under such circumstances, the production of good mutton is limited by the exertion the animal has to put forth in order to obtain its living. The owners of such stock are, of course, not the least anxious to fatten it, because, they say, it pays them much better to breed than feed. This is the case under the present condition of the pastures, while, if large areas were planted, the result would naturally be different and better; besides creating employment for a large number of people.

"Men constitute the wealth of nations" if industrious, but the nation must produce the raw material, or pay smartly for finding it elsewhere.

Gentlemen, if what I have stated to you will lead to further inquiry and action on the part of those who should be most interested, the landlords and the public, I shall not have spoken in vain.

II. *How to Combat the Attack of Injurious Forest Insects.* By WILLIAM SOMERVILLE of Cormiston, D.Œc., B.Sc., F.R.S.E., Lecturer on Forestry, Edinburgh University.[1]

The question which naturally suggests itself to our minds when we proceed to consider this subject is, "Are our woods really attacked by insects in such numbers as to warrant our going to the trouble and expense of adopting special measures to meet their attack?" or, in other words, "Would the net gain to be derived from eradicating or materially reducing the numbers of our forest insects outweigh the loss which their presence in our woods involves?" Now, this question may be answered in one way or another, according to the peculiar circumstances of each case. Whether we would be justified in resting content with simply adopting precautions designed to prevent the undue increase of insects, depends upon the amount of success which has previously attended such measures, and upon the danger which former experience and analogous cases would lead us to apprehend. Whether or not we would be repaid for going a step further, and waging a war of extermination against the insects which are already on our trees, depends upon the amount of damage which they are causing, and, in the event of their not being reduced in numbers, on the probabilities of their increasing to such an extent as to destroy a great deal more. In every case, too, we must take into consideration the nature of the preventive or remedial measures which can be applied, that is to say, whether they are cheap and easy of application, and effectual in operation.

As to the question of damage, I am sure that all careful observers who have spent much time in our woods must have come to the conclusion that our forest trees sustain an amount of damage each year through the attack of insects, which not only justifies but imperatively demands our taking some steps to prevent the recurrence of such damage in future. In making this statement, let me assure you I am not indulging in the amusement of conjuring up a phantom in order to show you how expertly I can cause it to vanish, neither am I alluding to anything so indefinite and undemonstrable that I would experience any difficulty in

[1] Paper read before the Royal Scottish Arboricultural Society at Dingwall, August 1890.

convincing even the veriest layman that much damage is being done, and that more is to be feared. For the proper understanding of this subject, some considerable knowledge of the habits and life-history of our forest insects is desirable, but perhaps I may, by taking a special case, be able to convince even the non-professional man that insects do play a very important and undesirable part in forest economy.

Suppose we go into a middle-aged or old Scots pine wood sometime during winter, and proceed to examine the thick bark at the base of the trees, more especially of those that are semi-isolated or situated near the edge of the wood, we shall find that it is perforated in exactly such a way as would result from the discharge of a gun loaded with No. 5 shot at a distance of about twenty yards. On following these perforations into the bark, we would find that they extended for an inch or so, but did not penetrate so far as the wood, and that each, or most of them, contained a small dark brown beetle in a semi-comatose condition, which we would have no difficulty in recognising as the well-known pine beetle (*Hylurgus piniperda*). I fear that at this stage our non-professional friend would be apt to remark that if this small and apparently lifeless creature cannot show more destructive work than that of boring into the dead tissues of trees, it can hardly be said to have earned the amount of reprobation to which it has been subjected. So much I am prepared to admit, merely remarking that if not distinctly destructive, neither is it positively beneficial to tree growth in its winter quarters.

Towards the end of March—a little later or earlier according to the character of the weather—the pine beetles withdraw from their winter quarters, and for the next two months are to be found under the bark of a certain class of tree. The conditions which the insects demand are very stringent, that is to say, so long as the conditions can be obtained, no trees will be attacked which do not fulfil these conditions. The trees most in request are pines which are sufficiently old to be provided with thick bark, and which have been dead for a month or more. The thick bark is necessary, because the transition stage from larva to pupa being passed not between the wood and the bark, but actually in the bark, there would not be space for the accomplishment of this process were the bark not of a certain thickness. Trees in robust health are, under ordinary circumstances, free from attack, probably because the insects are inconvenienced by the presence of too large quantities of viscid resinous substances; neither are trees infested which have been dead for a year or so, doubtless owing to the tissues being no longer suitable for the nourishment of the insects and their young. Why pines, and especially the Scots pine, are utilised by the insect for breeding purposes in preference to other trees can only be explained by the assumption that this particular insect has become gradually adapted for feeding in trees of this particular genus, just as the turnip fly only attacks crucifers, or *Scolytus Ratzeburgi* only birches.

Suppose, now, that we had taken our incredulous friend into a wood in April or May, and, having found a Scots pine which had been blown down or felled during the previous winter, were to show him the characteristic galleries of the pine beetle underneath the bark, he would most likely remain unconvinced of our having made out a strong case against the insect. He might say, and so far it would not be easy to contradict him, that surely the boring of even a large number of small passages underneath the bark of trees already dead, could do no great amount of harm, more especially as even the surface of the wood was hardly touched. If we were to cease our attempts at conversion at this point, we would be forced to acknowledge defeat, but the better course to pursue would be to pause and consider what would happen if the insects were to be placed in circumstances which would enable them to increase in numbers at a rapid rate. Now, in the absence of exceptional disturbing causes, practically the only limit to the increase of this beetle, and of many other forest insects, is interposed by the want of proper material in which to oviposit; that is to say, if a sufficient number of old Scots pines in a suitable state be provided, conditions are offered which enable the insect to increase in numbers to almost any extent. The most common cause of the production of a large quantity of breeding material is a severe gale, or a succession of severe gales such as we experienced in Scotland some years ago. At that time, as will be remembered, whole woods were levelled with the ground over wide areas of country, and for some years afterwards the timber could neither be cut up nor marketed. That, then, was an opportunity for *H. piniperda*, as well as for all bark beetles, to increase at a prodigious rate, and one which the results show they were not slow to avail themselves of. Let us look for a moment at the rate of increase of which such an insect as the pine beetle is capable when placed in the possession of an almost unlimited supply of breeding material.

Two beetles, a male and female, make a gallery in spring, and in it they deposit from 80 to 120 eggs; let us take the average and say 100. In ten weeks or so, these, having passed through the stages of larva and pupa, become beetles, of which 50 will be males and 50 females. In the same year, towards the end of July, these 50 couples proceed with the work of reproduction, each pair producing 100 young, so that by the end of the first year the numbers have increased from 2 to 5000. These beetles hibernate in the manner already described, and proceed to breed the following spring, when the 2500 couples will give birth to 250,000 individuals, and these, reproducing themselves in the same year, will, before the autumn is past, have multiplied to no less than 12,500,000 head. In these calculations no allowance has been made for those which would be destroyed in various ways, but if we even deduct 20 per cent. from each of the broods, we are still left at the end of the second year with over five millions of pine beetles as the result of our having neglected to destroy the original pair.

Some idea of the rate of increase may be gained in another way. Where pine beetles are abundant, the bark of suitable trees is undermined to such an extent that, on a large pine, scarcely a square inch will be found that is not occupied by the galleries of the parent beetles or their larvæ. From observations and measurements, I have calculated (allowing 40 square inches of bark to each family) that a large pine can produce quite 100,000 beetles, so that the leaving of ten large Scots pines, or of twenty average sized ones, lying on the ground, or standing dead in the wood, till the middle or end of July, is sufficient to ensure the birth of 1,000,000 pine beetles. Now, although comparatively little damage is done to timber during the breeding season, so long as the insect is represented by but small numbers, the case is entirely altered when a large increase has taken place, such as happened in Scotland a few years ago. In the insect world the principle of "first come first served" receives striking illustration. Those beetles which first awake from their winter's sleep exercise their usual discrimination, and oviposit only on thoroughly suitable material. It happens, however, when the insects are very abundant, that every particle of suitable Scots pine is occupied, with the result that late comers have to take what they can get, and are forced to oviposit on other conifers, such as the spruce, and, as I have found, on the larch as well.[1] Under such circumstances, comparatively

[1] *Proc. Roy. Soc. Edin.*, vol. xvii. p. 255.

thin-barked pines are also attacked, and, worst of all, growing trees, especially such as are somewhat unhealthy, are no longer safe. Let me cite two instances of a large amount of damage being caused by this insect using growing trees for purposes of oviposition. In the peninsula of Darss, in Pomerania, on the 12th and 13th of November 1872, the tide rose exceptionally high, with the result that a district stocked with Scots pines was more or less inundated. The effect of the sea-water upon the trees was to cripple their growth to some extent, and make them tempting objects for insect attack. During the next year or two pine beetles increased at an alarming rate, and totally destroyed all the pines on 2500 acres.

A similar experience, on even a larger scale, is reported from France. In the Department Gironde *Pinus maritima* is largely cultivated, chiefly for the purpose of binding the drifting sands. In the hard winter of 1879-80 the trees suffered severely, and the pine beetles consequently appeared in enormous numbers. The result of frost and insects together was the destruction of timber to the value of £1,680,000.

If any difficulty has been experienced in proving that *H. piniperda* is the perpetrator of an excessive amount of mischief when in its hibernation or breeding quarters, the task will be all too easy when we examine its life-history at other times. When the young insects hatched underneath the bark have reached the imago stage, they desert their birthplace and take to the young shoots of the pines, into which they bore, and usually cause their death. The damage is most apparent in plantations from fifteen to thirty years old, where it is no unusual thing to find that quite 50 per cent. of the trees have been deprived of their leading shoots again and again, and have been reduced from fine straight poles to little better than misshapen bushes. When this happens, and I am sure many instances of its occurrence must present themselves to your minds, the future prosperity of the wood can no longer be looked for, as it can, at the best, only produce poorly developed and badly formed stems.

In old woods the work of the insect in this way is not less destructive, if somewhat less apparent. Here, too, the young shoots, both of stems and branches, are its feeding ground. Into these it bores its way, and weakens them to such an extent that they are easily broken off by the first high wind, and litter the ground in large numbers. I believe that squirrels are often blamed for this work, but however destructive these creatures are in other connections, in this case at least the accusation is unjust. In old woods, where height-growth is nearly over, the damage chiefly consists in the loss of the organs of assimilation, namely the leaves, and the consequent reduction in the formation of wood. Owing to the loss of foliage, however, the fertility of the soil is also impaired, and, in a dry district especially, this consideration may be a very serious one.

It would be difficult to estimate the amount of damage done in Scotland by the pine beetle alone, but at all events it must be enormous. I know no part of the country where it is not present in large numbers, and its presence can be detected as well from a railway carriage as from actual examination on the ground. Running through any district which suffered severely from recent gales, or one where forestry is practised in an irrational or careless fashion, one cannot fail to be struck with the miserable appearance of many of the old Scots pines. Instead of being provided with dense rounded crowns of dark-green foliage, they are thin and of a pale colour, and, protruding from amongst the leaves, may be seen the extremities of bare dead branches, symptoms clearly testifying to the presence of vast numbers of pine beetles.

For the purpose of bringing before you the destructive work of forest insects, I have so far confined my remarks to the pine beetle, an insect, I am sure, familiar to you all; and my own conviction is that, even if this were the only insect which preyed upon our trees, the damage which it causes is far more than sufficient to compel us to adopt measures for its destruction and the safety of our woods. As you know, however, this is not the only foe which the forester has to fear in the insect world. To mention all would be a difficult if not an impossible task, and one which would take us far beyond the limits of time at our disposal. There are upwards of eighty European species of *Scolytidæ* (the family to which *H. piniperda* belongs), almost all of which prey upon trees or shrubs; then we have many species of *Aphidæ*, several very destructive weevils, including *Hylobius abietis*, the pine weevil, which is considered by many to be the most destructive of all our forest insects, and the caterpillars of many *Lepidopteræ* and *Hymenopteræ*. Mention must also be made of the cockchafer, which both in the imago and larval stages works fearful havoc amongst our forest trees. In France, during years when this insect is specially numerous, it is said that damage is done to fields and forests which is estimated at £40,000,000.

Seeing that forest insects are so numerous, and so varied in their methods of attack, it is manifestly impossible that, in a short paper like this, I can do more than briefly summarise the general and indicate a few of the special measures which can be adopted to eradicate or keep them in check. This subject may be conveniently treated in two divisions. We shall, first of all, look at such measures as are designed to keep insects in check, and prevent their ever increasing to such an extent as to threaten our woods with a calamity; and, secondly, at remedial measures, to be put in force only when the others fail, or have been neglected, and danger is at hand.

Measures for the prevention of the increase of forest insects are to be looked for as coming either from the side of the natural enemies of the insects or from the management of the woods. The natural enemies of insects are to be found in most divisions of the animal kingdom. Many insects live entirely, or for the most part, by preying upon other insects. Such creatures as lizards and frogs destroy insects in large numbers. Several mammals destroy large numbers of insects, but unfortunately many of them cause damage in some way or other which prevents our unconditionally advocating their encouragement. This is the case, for instance, with the fox, hedgehog, weasel, mole, and mouse, all of which devour insects in one form or other, but nevertheless whose presence in our woods cannot be regarded as altogether an unmixed good. The two most useful mammals in this country are probably the bat and shrew. Neither of these creatures does any appreciable amount of damage, and they subsist, one may say, all but entirely upon insects, and therefore deserve every encouragement to live and increase.

The best friends of both farmers and foresters are undoubtedly to be found amongst the birds, many of which subsist entirely upon insects or their larvæ. A foremost place in the list, in point of individual usefulness, must be assigned to the cuckoo, which preys largely upon hairy caterpillars, insects which, for the most part, are avoided by other birds. It has been noticed, when caterpillars become very numerous in fields or woods, that cuckoos congregate in such places in large numbers, and, as they are extremely voracious, they do much to mitigate insect ravages. Unfortunately cuckoos are, on the whole, not very numerous in this country, to which also they are only summer visitants, but they have the advantage over other birds that, being perfectly unimpeded in their movements by the cares and duties of incubation, they are always ready for action. The tree-creeper, common wren, gold-crested wren, and tits are great destroyers of injurious insects, which, on account of the small size, scansorial habits, and wonderful activity of these birds, are safe neither in the deepest bark-fissures nor on the most delicate of twigs. Their usefulness, therefore, no less than the charm they lend to our woodlands, renders these birds worthy of every protection. Then, we have swallows, pipets, wagtails, the hedge-sparrow, warblers, the redbreast, red-start, chats, fly-catchers, and the starling, all of which are useful in the highest degree, and, if we except the starling's partiality for cherries, possess no bad qualities to detract from their merits. Many other birds, such as the rook, jackdaw, sparrow, finches, and owls, destroy insects when they come in their way or when no other food presents itself, but, on account of the damage which they cause to crops or game, they cannot be regarded as worthy of unconditional preservation, though, under certain circumstances, the advantages which their presence ensures may outweigh any drawbacks.

Now, it must be borne in mind that it is not sufficient merely to preserve our useful birds from destruction, but means must also be taken to secure their increase. This may be accomplished in a variety of ways. During severe weather in winter, food must be supplied. Very suitable for this purpose are the cleanings of grain or hay-seed, though for tits animal food, such as lard, must be provided. In order to set it beyond the reach of crows, dogs, cats, etc., it should be placed in the shell of a cocoa-nut or some such receptacle, and suspended by a string from the bough of a tree.

The numbers of our useful birds may also be largely increased by providing them with suitable nesting and sleeping places. Many of the forester's best friends only breed in holes, so that unless hollow trees, loosely-built walls, or artificial breeding-places are to be had, it is quite impossible for them to build their nests and rear their young. Holes in trees and walls are the places where, in this country, nearly all our hole-breeding birds are reared, but, as a general rule, such places do not offer great safety from the attacks of cats, weasels, and other predaceous animals, either to the parent birds or their brood. It is, therefore, much better to provide artificial nesting-boxes prepared from light boards coated with tar, which can be so constructed, and fixed in such a position, as to ensure for their tenants perfect safety. A firm in Leipzig is prepared to supply any number of nesting-boxes at the average rate of 6d. each, a price which, I think, need not be much, if at all, exceeded in this country. In fixing the nesting-boxes on trees the following points must be observed:—For titmice the boxes must not be placed at a greater height than 12 feet from the ground. They should only be fixed on conifers, and, if possible, on dense conifers, such as spruces and silver firs. For red-starts and fly-catchers the boxes should be fixed on isolated trees, or on such as stand near the edge of a wood. In the case of boxes for starlings, any number may be fixed on the same tree, but in the case of all other birds there must not be more than one box on each tree. In all cases it is found that the best results follow when the boxes are fixed on the south or east side of the tree, the west side being the most unfavourable.

So far as the system does not violate the principles of good sylviculture, all hollow trees should be allowed to stand, for not only do our useful birds find nesting-places in them, but they are also largely used by bats as sleeping-places. I may be allowed to mention an experiment I made last spring, and from the success which has already attended it, I hope to extend it next year. In the part of Scotland where the experiment was made there is a great scarcity of trees suitable for the nesting of our hole-breeding birds. We do not lack the hollow trees so much as the means of entrance into them, that is to say, there are plenty larches and spruces which are decayed at the centre, but which are useless to the birds on account of their hollow centres being surrounded by firm wood. Now, it is evident that such trees are of very little commercial value, but with a little ingenuity they may be made most valuable in another way. One has only, by means of a chisel or large augur, to pierce the wood and establish communication with the centre, to make all such trees nurseries from which a large number of titmice and tree-creepers will be sent forth annually. As such trees are, at the best, only fit for conversion into inferior paling-stobs, no real damage is done to the timber if the entrance holes be made at the height of a stob length, say 5 feet, from the ground, while the gain which ensues through the destruction of noxious insects far outweighs any little trouble we may be put to in providing for the wants of the birds. Both titmice and tree-creepers breed twice in a season, and produce six to ten young on each occasion. Each bird, it is calculated, destroys two or three hundred thousand insects annually, chiefly in the form of very minute eggs. Five thousand insects are often sufficient to completely denude an average-sized tree of its leaves. If such defoliation be repeated a second year, the probabilities are that the tree will die. The annual produce of one breeding-place, say twelve titmice, can destroy two and a half millions of insects each year, which would be sufficient to entirely denude five hundred trees of their leaves.

The preventive measures which we have considered come from the side of the enemies of the insects, the other set is more directly due to the management, and may naturally be subdivided into the following heads:—

1. *The Establishment of the Wood.*—Strong well-developed plants should be selected, as they are best able to withstand insect attack. In the case of danger from the attack of the pine weevil, only such young trees should be used as have been reared in comparatively open nursery lines, because plants which are much crowded when young have thin and delicate bark, and suffer very severely from this insect. Where a variety of trees thrive equally well, it is always advisable to cultivate mixed woods. This precaution is necessary, because, as a general rule, each species of insect prefers but one species, genus, or class of tree, and great calamities are only known in pure woods. It is scarcely necessary to say that great care must be exercised in inserting the plants in the ground, so that their growth may be interfered with as little as possible, for it almost always happens that the weakest plants are the first victims. One should also avoid as much as possible forming large compartments of wood of the same age. It is much safer to divide large woods into age-classes, because many insects confine their attack either to young or to old trees, but do not attack trees of all ages indifferently.

2. *The Tending of the Wood.*—Thinning should be begun before there is any chance of the density of the crowding interfering so much with growth as to weaken the vitality of the trees, but, at the same time, care must be taken that over-thinning is avoided, otherwise fertility suffers, and the evil we wish to avoid is encountered. During the operations of thinning, all trees which

are unhealthy, or which have been damaged by wind or snow, must be removed, and a watchful eye should constantly be kept on the woods, so that trees which appear likely to die are at once removed, as it is in such trees, or in trees which have just died, that destructive insects find their most congenial breeding-places. The practice of only removing trees from the wood some months after they have died does nothing to keep insects in check, for it is not dry and withered trees, but such as are still supplied with sap, that forest insects make use of for breeding purposes.

3. *Harvesting the Timber.*—Nothing conduces so much to the increase of many destructive insects as bad management in connection with felling and utilising forest produce; and, conversely, woods which are well managed in this respect are preserved from the attack of many insects. The chief point to be observed is to get the felled timber removed from the wood, and marketed or converted as quickly as possible. Where any difficulty is experienced in this respect, it should at least be peeled, and, if possible, peeled at a time when the bark is full of larvæ, for, by so doing, large numbers of destructive insects are got rid of, and the practice, from being merely preventive, becomes remedial. These precautions are most necessary in the case of conifers, for it is in them that forest insects breed most abundantly. Where the ground is suitable the trees should be cut close to the ground, but where, as on steep declivities, this cannot be accomplished, the stools ought to be stripped of their bark. It is sometimes possible to get the bark removed without incurring any expense by allowing cottagers to strip it off for firing purposes, and the same holds true with regard to branches and the general refuse left after trees are felled. Not only do stools and branches supply breeding-places for *Scolytidæ*, but also for weevils, hence the reason why *Hylobius abietis* is so destructive to young trees planted on land previously occupied by conifers.

The preventive measures which have been noted do not by any means exhaust the list, though they are certainly the most important. Let me now say a few words with regard to measures for the general eradication of insects.

Theoretically, insects may be destroyed during any or all of the four stages of their existence, that is to say, as eggs, larvæ, pupæ, or imagines, and also during any season of the year; but in practice the best stage or season to select depends upon the life-history of the insect to be destroyed. It is comparatively seldom that the egg stage is selected, though an exception presents itself in the Black Arches moth (*Liparis monacha*). The larva stage is the one most commonly chosen, and is almost general in the case of butterflies and moths. It is also frequently resorted to with beetles, *e.g.*, the whole of the *Scolytidæ*, *Melolontha vulgaris*, etc. The pupa stage is not often selected, chiefly because it is usually of such short duration, and, on the whole, neither is the imago stage, though pine weevils, cockchafers, and certain moths are destroyed in large numbers as perfect insects. As a general rule, one is guided in the choice of the stage and season by that which offers the most opportunities, and for this reason the larval stage is most usually chosen, because many injurious insects pass the greatest proportion of their life in the state of larvæ, and are at that stage most easily caught.

The destruction of forest insects may take place (*a*) when the insect is feeding, breeding, or hibernating in its natural haunts, or when moving to or from its breeding or feeding ground; or (*b*) in special lures prepared to attract the insects to them for the purpose of feeding, breeding, or shelter. We shall now look shortly at some special eradicative measures which can be applied along these two main lines.

Destruction of Forest Insects when in their Natural Haunts.—In countries where cockchafers, *Melolontha vulgaris*, are numerous, advantage is taken of every opportunity to destroy them, and huge numbers are captured by hand-picking. Early morning and dull days are chosen, because at these times the beetles are slow in their movements. The work is chiefly performed by women or children, who are paid at a certain rate per pound (1 lb. contains about 550 head). From reliable sources I have collected the following statistics to show what enormous numbers of cockchafers are from time to time collected. In 1836 a society for the destruction of cockchafers at Quedlinburg, in Saxony, paid out £40 for the capture of 33,000,000; in 1860 a private individual in Salzmünde paid £45 for some 22,000,000 head. In 1864, in the neighbourhood of Leipzig, over 378,000,000 were collected. In 1868 Saxony was practically overrun by cockchafers, and the secretary of the Central Chamber of Agriculture, Dr Stadelmann, issued a strong appeal for their destruction, at the same time issuing instructions as to how this might best be accomplished. The appeal was generally acted upon, with the result that there were collected nearly 1400 tons, or a grand total of something like 1,600,000,000 head. In

Wurtemberg, in 1872, about 231,000,000 cockchafers were gathered and destroyed.

Dead cockchafers have been put to the most varied uses. They have been proved to furnish first-class food for pigs and poultry, they form an excellent manure, and have also been employed in the manufacture of waggon grease and printing ink; and a silver-amalgam work near Freiberg was for several years lighted with gas obtained from the dry distillation of cockchafers.

The pine weevil is often captured in large numbers by hand-picking. This can be performed by children, who in early summer search the woods formed during the previous winter. The captured insects are best placed in small bags, the mouth of each being furnished with a bottle-neck to prevent them finding their way out easily.

Another method of catching pine weevils has many advocates. It is, however, only applicable to cases where the surface is fairly level, and the soil firm but not very stony. The *modus operandi* is as follows:—When a coniferous wood has been felled during winter, the area is, immediately after the removal of the trees, surrounded with a trench 10 to 12 inches broad and as many deep. The sides must be perpendicular, and as smooth as possible. At intervals of ten paces or so there are constructed, in the bottom of the trench, special pitfalls, 4 to 8 inches deep. These trenches must be visited every few days, and the captured beetles destroyed. As the trenches are apt to become damaged or silted up during heavy rains, they must be frequently examined, and, if necessary, repaired. The object of this method is the capture of all pine weevils which are making towards the fresh stools on which to deposit their eggs, as well as those which have been hatched there, and are proceeding to the adjoining young woods to prey on the trees. The system is largely employed in many parts of Europe, and where the conditions are favourable, it is both cheap and efficacious. In the trenches are captured not only pine weevils, but also other destructive weevils and insects generally, which are incapable of or averse to flight.

The preventive measure employed in the case of the winter moth, *Cheimatobia brumata*, at present devastating the orchards in the west of England, falls under this heading. As is well known, the imago stage of this insect is attained under the earth, after which the wingless females proceed to crawl up the stems of fruit and other broad-leaved trees for the purpose of depositing their eggs in the buds. The most effectual way of destroying them consists in taking advantage of their natural habits, and interposing obstacles to their ascent of the trees by surrounding the base of the stems with rings of some viscid material, in which they stick and perish.

Instances might be cited of other eradicative measures of the same nature as those already given, but enough has been said to indicate the general principles of such measures, and time compels us to hasten on to look at the other group.

Destruction of Insects by means of Lures.—Measures of this kind are the most easily arranged and supervised, and are, generally speaking, the most effectual. They have this point in common, namely, that the insects are not actually sought for, but are induced to congregate in certain specially arranged places, where either they or their eggs, larvæ, or pupæ may be easily captured and destroyed.

Pine weevils can be kept down, if not eradicated altogether, by laying out spruce or Scots pine logs, upon which the beetles deposit their eggs, and these, or rather the larvæ which result from them, are afterwards destroyed. The system succeeds best on ground previously stocked with conifers, where, however, the old stools have been trenched out. Fresh stems of spruce or pine 3 to 4 inches in diameter are selected, which are cut into blocks 4 or 5 feet in length, care being taken to preserve the bark as entire as possible. These logs are buried in the ground in the month of May, in such a way that the thick end is covered to the depth of a foot or so, while the thin end projects above the ground 2 or 3 inches. The soil and turf are afterwards replaced, and the whole firmed somewhat by tramping. About twelve such lures are enough for each acre, and in order to facilitate finding them, some sort of order should be observed in laying them down, and their position should be marked by wooden pins or stakes. In any case, such lures are largely made use of for oviposition, and when no old stools are present to act as counter-attractions, nearly every female pine weevil finds her way thither, and not only weevils, but many other destructive insects besides. In the month of October the blocks are carefully dug up, and the bark, with the larvæ which it contains, is stripped off and burned.

A lure of another kind is largely used in the destruction of pine weevils, which attracts the insects not for purposes of oviposition, but solely for food. This lure consists of sheets of the bark of the spruce or Scots pine of a convenient size, say 15 by 10 inches, which are laid out, bast downwards, throughout the young wood, at distances of twenty paces or so. Underneath each sheet are placed a few young twigs of the Scots pine, which greatly assist in attracting the insects, and on the top of all is laid a sod or flat stone to keep the bark from drying up too quickly. The lures should be renewed and replenished two or three times during the season, as the old material is apt to lose its charm. Each morning from April till September, these traps are visited either by the forester, or, which is cheaper and equally suitable, by a boy or woman, and the beetles which are found are removed and destroyed. This is the best remedy for pine weevils that has ever been discovered, and is employed with conspicuous success wherever these creatures abound.

The pine beetle, and all the other members of the great family of the *Scolytidæ*, can be best, and indeed only, eradicated through providing material on which they may oviposit, and in which their young may afterwards be destroyed. The procedure is very simple, and the results highly satisfactory. From February till September, at intervals of a month, trees, which in the ordinary course of things would be removed, are felled and allowed to lie for six weeks or so, at the end of which time they are peeled and the bark burned. The number of "catch-trees" which one should prepare depends entirely upon the abundance of the insects. If it be found that all, or almost all, the available space in the trees is occupied by breeding galleries, then it is evident that too few trees have been provided. If, on the other hand, the catch-trees are not much attacked, then fewer may in future be laid down; but on every well-managed estate a considerable number of such lures should always be present. One must also arrange the species of tree to be used as a lure according to the species of insect one wishes to destroy. The majority of the *Scolytidæ* infest pines, but *Bostrichus typographus* attacks the spruce almost exclusively, *Scolytus destructor* the elm, *Hylesinus fraxini* the ash, *Scolytus Ratzeburgi* the birch, etc., so that it may be necessary to prepare catch-trees of many species, though in the great majority of cases the Scots pine suffices.

In connection with these lures, the greatest amount of care must be bestowed upon the selection of the right time in which to peel the bark and destroy the broods. If peeling be done too soon, the bark is not occupied by so many insects as it can afford space for, and consequently an excessive number of catch-trees must be prepared, entailing increased labour and greater expense. If, on the other hand, one delays too long before proceeding to strip the bark, many or most of the broods may have reached the imago stage, and have deserted their breeding ground, with the result that not only are the ends of the whole system frustrated, but the wood is actually left in a worse state than it would have been had no such lures been prepared. As it is unnecessary to remove the bark before the larvæ are half-grown, and unsafe to delay till the pupæ are formed, the best time to destroy the insects is towards the end of the larval stage, but better a week too soon than a day too late. It seldom happens that all the broods are found at the same stage of development at the same time; but there must be no striking of averages, it is those that are furthest advanced which must guide the forester in his selection of the right time to peel and burn.

It is not now my intention to discuss the question of State interference in the destruction of forest insects. In many countries of Europe laws have been enacted to regulate forestal operations, so as to minimise the chances of an outbreak of forest insects, and also for dealing with an outbreak when such occurs. In this country, however, the State has, so far as I am aware, never interfered with regard to forest insects, nor, on the whole, do I consider that such interference would be desirable. That our management is none of the best cannot be denied, but with a system of more intensive forestry, I hope soon to see signs of decided improvement. In common with most other civilised countries, we have a Wild Birds Protection Act which has done good service in the past, and which only requires to be more stringently enforced to be capable of imparting still greater benefits in the future.

III. *On British Oaks.* By John Smith, Romsey, Hants.

Botanists divide the British oaks into three varieties, and hold that there is only one species indigenous to the British Isles, namely, *Quercus robur;* the varieties being (1) *Q. robur pedunculata,* (2) *Q. robur sessiliflora,* and (3) *Q. robur pubescens,* or *intermedia.* The first of these, however, is the prevailing tree, and may claim to be the true "monarch," as most of the giants in our land are of the variety *pedunculata.* The distinctive features of the varieties are—(1) *Pedunculata* has no foot-stalks to the leaves, and the acorns are on long stalks. (2) *Sessiliflora* has stalks to the leaves, and short flower-stalks, hence its botanical name; its common name being dur, or durmast oak. The timber is said not to be so durable, but the bark contains a percentage more of tannin, and it enjoys a greater immunity from insects than *pedunculata.* It occurs in Dean Forest, the New Forest, Sherwood, and in other parts of Great Britain. (3) *Pubescens,* or *intermedia,* may be distinguished from the last by the underside of the leaves having short hairs, which, when the leaf falls, has a dull, leaden-like appearance; and as this seems to be the only apparent difference, it is evidently only a variety of *sessiliflora.* In Hooker and Arnott's "Botany" it is said: "Dr Greville has shown that there is no connection whatever between the relative length of the fruit-stalk and the petiole. The flowers are sessile upon the peduncle in both varieties; but in *sessiliflora* it is mostly very short, or almost wanting, in *pedunculata* much elongated; between these there is every gradation. *Intermedia,* or *pubescens,* is said to have the lobes of the leaves separated by obtuse angles; but both kinds may be observed on the same branch, and sometimes on the same leaf."

Comparative Value.

With regard to the comparative value of the timber of *Q. r. pedunculata* and *Q. r. sessiliflora,* leaving out *pubescens,* which is merely a variety of the latter, the merchant will give the same price for trees of equal size, so that there is really no difference in their value. But at the time when oak timber was in demand for the navy, *sessiliflora,* or the durmast oak, was not considered fit for that purpose; indeed, it was through the purveyors for the navy that the distinction was often drawn as to its inferior quality, being, it was said, more liable to dry-rot, and this tradition still lurks in the minds of the older woodmen, several tales being told and localities named as to how these worthy gentlemen were deceived into passing the durmast oak; but in latter years, as I have said, it will command the same price. This being the case with regard to the buyer, it would seem that there is no difference; but in looking at the matter from the seller or grower's point of view, the case is different, as *sessiliflora* increases in bulk faster than *pedunculata*, and, taking the two trees mentioned at page 25 as representing the comparative rate of growth, we find that the former increases after the rate of 5 feet in ten years, whilst the latter increases only 3 feet in the same time; and, if we put this quantity at 2s. 6d. per foot, the money stands at 12s. 6d. and 7s. 6d. respectively.

It has already been mentioned that the bark of *sessiliflora* contains a percentage more of tannin, but I doubt whether this can be appraised to any advantage, as a tree of *pedunculata* of equal size to the other will throw a greater weight of bark, the bark of *sessiliflora* being thinner, presumably owing to its more rapid growth.

The timber of the oak is superior to that of any other native tree, and it has been said of it "that, although some of the other descriptions of timber may be harder, some more difficult to rend, some that can bear a horizontal or lateral strain better, none contains all these qualities united in such a superior degree as the oak." Although the "wooden walls" are a thing of the past, still the price has not diminished; indeed, the tendency is rather upwards. But the price of bark varies, as in some years it is so low that it scarcely pays expenses, whilst in other years it pays well. Much, of course, depends on the season being favourable or not. It would be hazardous to say whether the many substitutes which now and again crop up will ever entirely displace it for tanning purposes. A company with large capital has been recently started with the object of importing the boiled down bark of the spruce as a substitute—a hint which might be useful in this country for oak bark as well as spruce, for in certain seasons, especially wet ones, it would be a great saving to boil down the bark as soon as the trees are stripped, and cask the liquor for future use.

Soil and Situation.

Oak will grow and come to perfection as a tree in almost any description of soil, provided it is not too wet, and has a depth of from 3 feet to 4 feet. But the best timber is produced on strong clay, resting on a subsoil of gravel or chalk. It will grow faster on lighter soils, but the timber is more liable to be shaky, and consequently not so good. Where the soil is not naturally suitable for the oak, it is a waste of money to attempt its cultivation.

The situation of an oak plantation should be sheltered; and when not naturally so, nurse trees, such as Scots fir, spruce, larch, or birch, should be introduced. I prefer the three last, as not so apt to overcrowd the oaks, but great judgment is required in this matter. Furze or whin has been recommended, and no doubt has some advantages, in that it is short-lived, and would decay when its shelter was no longer required; but, on the whole, I prefer larch, or any fast-growing deciduous tree for sheltering the oak in its infancy. A belt of Scotch fir on the most exposed side may be advisable, there to remain until ripe. A practice has prevailed in the New Forest of Hampshire of planting the oaks with alternate rows of Scots fir, the rows running due north and south. This practice is evidently a failure, as the oaks are drawn up so spindly that they cannot support themselves. This is partly due to the fact of too many Scots firs being planted, and also to the want of timely thinning. The excuse for this last is the reluctance to cut down nice thriving plants before they are fit for some commercial purpose.

Having selected a place on which to raise oak for timber, a question arises whether the acorns should be sown in the place where they are intended to remain, or whether they should be sown in a seed-bed, and afterwards transplanted. This question seems to be decided by the paper which Sir James Campbell, Bart., submitted—as the result of experiments in the Forest of Dean—to the International Forestry Exhibition at Edinburgh in 1884. In analysing this paper, I will first take certain periods; and as the year 1822 saw four out of the six non-transplanted trees cut down, leaving but two, I will only deal with them, and taking the period of 38 years, that is, from 1784 to 1822, the increase was for—

L, $20\frac{1}{8}$ in., or an average rate per annum of . . ·565 in.

Another 38 years brings us to 1860, or an age of 76 years, when the size was 45 in., or an average of . . . . . ·592 in.

The last 38 years shows the increase to be slightly in excess of the first 38.

M had increased in 1822 to $26\frac{3}{8}$ in., or an average rate of . . . . . ·609 in.

,, In another 38 years it had increased to 43 in., or an average rate of . . . . ·563 in.

Then take two of the transplanted for the same periods, as follows :—

A had increased in 1822 to $26\frac{3}{8}$ in., or an average of ·641 in.

,, In 1860 it had increased to $74\frac{1}{4}$ in., or an average of ·936 in.

B had increased in 1822 to $25\frac{1}{4}$ in., or an average of ·664 in.

,, In 1860 it had increased to $69\frac{1}{4}$ in., or an average of ·911 in.

The first thing that strikes one with reference to the above is the great difference in size between the non-transplanted and those that were. In the 76 years "A," a transplanted one, exceeded "L," a non-transplanted, ·344 in. per annum, and "B" exceeded "M" in the same time by ·348 in. Now it is difficult to believe that the mere fact of transplanting would result in such a difference, all other conditions being equal, and this at the end of 76 years, without any other reason than that the tree *was transplanted*. I have taken the period of 76 years, because I happen to be well acquainted with a self-sown wood of about the same age, and in 1888 measured several, with the following results :—

No. 1 had a circumference of 60 in. at 5 feet up, or an average increase per annum of . . ·789 in.

The bole or trunk was 60 feet, and the sheer height 80 feet.

No. 2 had a circumference of $65\frac{1}{2}$ in., or an average increase per annum of nearly . . . ·862 in.

The bole or trunk 40 feet, and the sheer height 80 feet.

No. 3 had a circumference of 74 in., or an average increase per annum of . . . ·970 in.

The bole or trunk 30 feet, and the sheer height also 80 feet.

The above examples show that the length of the bole affects the circumference, that is to say, the longer the bole is the less the girth, and *vice versa*, and this leads me to remark that in Sir James Campbell's paper the length of the bole is not given, an important omission.

Another objection to this experiment has been stated, namely, that the plants left in the "acorn patch" were in exhausted soil, whereas the transplanted ones were put in comparatively maiden soil.

An argument put forward in favour of transplanting is, that the tap root only serves a temporary purpose, and is of no consequence to the future growth of the tree. This opinion is founded on observations taken of uprooted trees, which have no appearance of tap roots. In answer to this it may be stated, first, that the absence of a tap root may have been the cause of the uprooting, because whether self-sown or planted, there may have been circumstances in the subsoil unfavourable to its growth.

Another omission in Sir James Campbell's paper is that the variety of the oak is not given. Now I find that *pedunculata* does not increase so fast as *sessiliflora*. I found this opinion on the measurement, for ten years, of two trees which, so far as can be seen, are growing under precisely similar circumstances.

No. 1. *Quercus pedunculata*, measured in 1878, had a circumference of	11 ft.
The bole 9 ft.	
,, In 1888 the circumference was . .	12 ft.
This gives an average increase per annum of .	1·2 in.
No. 2. *Quercus sessiliflora*, measured in 1878, had a circumference of	9 ft. 3 in.
The bole also 9 ft.	
,, In 1888 the circumference was . .	10 ft. 11 in.
Or an average increase per annum of . .	2 in.

nearly double that of No. 1. The soil in which they grow is clayey loam. Another *Q. sessiliflora* is increasing at the rate of ·875 in. per annum; but this is evidently an older tree than No. 2, and is growing on stiff clay.

Plants and Planting.

Whether the foregoing statements as to the growth of the two oaks, which are natives of Britain, will bear out the theory that *sessiliflora* grows faster than the other, it is still desirable to have a mixture of *sessiliflora* in a plantation, for the reason that the bark of the thinnings is of more value, and would be almost the only return in the earlier years of the plantation. In preparing the land for planting, no better method can be adopted than to crop it with potatoes, which pulverises the soil better than the cultivation of any other crop. The oak plants, four or five years transplanted, should be put into pits at 4 feet apart each way, to be successful, and this operation will require to be carefully done. For the first three years the plantation should be hoed annually, after which tall weeds, brambles, etc., can be cut down as occasion requires.

Thinning.

The thinning may commence from the seventh to the tenth year, and here great judgment is required, as no hard and fast rule can be laid down. The only plan that can be recommended in the first thinning is to cut out the weakest plants, and if two or more robust plants are found side by side to leave them alone for another time. Before the second thinning, which may be taken in another seven or ten years, all the undergrowth should be cut clean out. The trees will now be, say, twenty years of age, and greater judgment, if possible, will be necessary at this thinning, as the proportions of the trees and their likelihood to become useful timber must be calculated with a skilful eye, and the fittest selected to remain. Some writers have recommended that a certain number per acre should be left, and that they should stand at equal distances apart. This is questionable advice, for in all probability there will be three classes of trees in the plantation, namely—first, those with a straight leader going ahead; second, those with a short stem, and inclined to have a branchy head; and third, those which it would be difficult to class as a tree or shrub. These last should all be cut over, unless there are special reasons to the contrary, as the shoots from the stools will come in to be cut as underwood at the next thinning. The second class to have plenty of room to develop their head, as in consequence of their short stem they will be the first to come in as marketable timber. The first class may be left closer together; two or more may be no farther than 8 feet apart, as many fine timber trees are found growing as close. In the third thinning proceed as in the second, and the cuttings of the underwood should now be of some value. Care should be taken to leave all seedlings which may have sprung up, but none of the shoots from the stools should be left, however promising they may look, as trees grown from such are generally faulty at the butt, and otherwise unsatisfactory when they attain maturity. The trees being now about thirty years of age, some of the short stemmed ones will come in as useful timber, but no more should be taken out than is absolutely necessary to make room for the others, as no greater mistake can be made than in taking too many trees at a time.

Diseases of the Oak.

Insects.

The oak, although lord of the woods, is more subject to the attacks of insects than any other tree of the forest. One authority has stated that there are nearly 130 species of galls living on various kinds of oaks in Europe. In this paper it will be sufficient to notice only those that are common in Britain.

First, the *Marble Gall,* so called from its appearance, being like a common marble as used by boys in play. It is perfectly round, brown, and gets very hard in autumn, and with clusters of three or four gives the tree a strange appearance when denuded of leaves. It occurs mostly on young trees, or those that have been pollarded, seldom or never on large growing trees. This gall is produced by an insect known as *Cynips Köllari.* Its history is somewhat obscure; but the grub occupies the centre of the gall, and lies in a curved position, emerging from it in spring a perfect fly. During the winter many of the galls are pierced by birds and the grub extracted. This, no doubt, tends to check their increase.

The *Apple Gall,* or "oak apple," is occasionally very plentiful, and generally found at the end of a shoot. The galls begin to form at the end of April or beginning of May, and are full grown by "oak apple day," or the 29th of May, the anniversary of the restoration of Charles II. Sometimes they are $1\frac{1}{2}$ inches in diameter, of a greenish-white colour streaked with red, at first soft, but harden somewhat before they fall from the tree; they are then found when opened to contain many grubs, each in a separate cell. The perfect insect, *Terax terminalis,* emerges in July.

The Root Gall.—The females deposit their eggs in the roots which they can reach near the surface of the ground. A large number of eggs are laid close to one another, and no doubt two or more females deposit their eggs so close together that they form one gall. The eggs are laid in August, and the galls begin to grow in September, but from the fall of the leaf until the spring they do not increase in size. In May they are full grown, but the gall flies do not emerge until the following April. The galls vary in size from about $\frac{3}{4}$ of an inch to 3 inches diameter, and will be found full of small oval cells, each containing an insect. The flies which issue from these galls are known as *Aphilotrix radicis*, and only females appear in this generation. They are much larger than their parents, measuring nearly a quarter of an inch in length. They leave the galls in April or May, and deposit their eggs in buds which form the young shoots, causing swellings to appear at the base of the shoot, from which the flies emerge in August. This species, therefore, requires two years to complete the cycle of its transformation.

The Artichoke Gall, so called from its resemblance in form to the globe artichoke. This is formed by an insect called *Andricus pilosus.* Both sexes appear in June, and the female lays a single egg in a bud, which causes it to grow into a scaly bract. On cutting open one of these galls the interior will be found of a woody texture, and partly embedded in the top is a small, hard, brown, oval striated gall, which contains the grub. This gall eventually falls to the ground, when the transformation of the insect is completed. In the woody portion of the outer gall may often be found cells containing grubs of some other species, which has laid eggs after its formation was begun. The perfect insects, *Aphilotrix fecundatrix*, bred from the internal galls, are about one-eighth of an inch in length, and always females. They appear in April, and attack the buds containing the male flowers, within which their eggs are laid. The galls which result are oval-pointed, about one-tenth of an inch in length, covered with stiff hairs, and of a green colour. The perfect insects, which are of both sexes, escape from the galls in June, and attack the leaf-buds as already mentioned.

The Spangle Gall insect (*Spathegaster baccarum*) deposits its eggs on the underside of the leaf at the beginning of June, and the galls begin to form in July, and are full grown in September, when they are about three-tenths of an inch in diameter. They are flat and circular, with the centre raised in a flat cone. They are of a greenish-yellow colour, with tufts of red-brown hairs, and sometimes cover the entire underside of the leaf. They were very numerous in 1886. The insects lie dormant during the winter, of course falling with the leaf. They appear in the winged form in April or May.

The Button Gall (*Spathegaster vesixatrix*) is formed by a small species of about one-tenth of an inch in length, both sexes of which are produced. The female deposits her eggs on the underside of the leaves in June, and the galls are about one-tenth of an inch in diameter. They resemble a small button covered with fine threads, which under the microscope are very beautiful. The flies do not emerge from the galls until spring, when only females are produced. These attack the undersides of the leaves, which causes small galls, somewhat resembling the oak spangles.

The Currant Gall (*Neuroterus lenticularis*).—This fly is about one-eighth of an inch long, and of a reddish-brown colour. The females deposit their eggs in the buds containing the male flowers, and also on the undersides of the leaves. The galls when mature are perfectly globular, of a transparent green, speckled with red. They are of a soft consistency, with a considerable hollow space in the centre, in which is the grub. When formed on the male flowers they resemble a bunch of currants. The flies emerge from the galls in June.

Such is an account of the more common of the galls to be found on the oak in Britain; but what the effect is on the growth of the tree it would be difficult to say, as they have occurred in most years for ages past, with perhaps the exception of the *marble gall*, which is stated to be a more recent introduction.

We now come to a more serious class of insect pests, namely, the caterpillars, chief among which is the *Tortrix viridana*, or oak-leaf roller. This caterpillar attacks the leaves, and has assumed alarming proportions at intervals of years apart, such as in 1831, 1848, 1864, and 1881. This gives a period of about seventeen years between each attack. I particularly noticed the latter years, but in 1888 their ravages were the most disastrous of any. On the 1st of June in that year, a bright sunny day, I entered an oak wood, and, after proceeding a short distance, became conscious of being enveloped in cobwebs. On discovering the cause, so thick were the caterpillars hanging by their threads all around me, that I determined to return, and although the distance was but short, I emerged literally covered with them. During that month they continued their ravages until whole woods were denuded of their foliage, and looked as bare as in mid-winter, and so annoying were they that labourers could not work in the woods. They also attacked the hazel under the oak, surrounding some of the bushes with their webs as if in a glass case. It was only in the close woods where the ravages took place, isolated oaks not being touched. The trees which enjoyed immunity, although surrounded by infested oaks, were the elm, beech, sweet chestnut, and the Turkey oak, and the ash partially. During the height of the attack I passed through a wood composed of *Q. sessiliflora*, which, although the attack had been begun, they had left off evidently either poisoned or starved. This fact has also been noticed by a resident in the Forest of Dean, who, in writing of 1881, says, "It was strikingly evident last summer that the *Q. robur pedunculata*, or old English oak, was attacked by blight more severely than the *Q. r. sessiliflora*. Single trees and groups of several together would be seen in full foliage, or but slightly injured, and, when examined, these were found to be of the last-mentioned variety, while all around them *Q. r. pedunculata* would be leafless and bare." This is another proof that *sessiliflora* is distinct from *pedunculata*. On the 2d of July 1888 very heavy rain began to fall, and continued at intervals for a week. Then the trees that seemed to be dead began to sprout, and the mid-summer shoots soon clothed them in verdure again. Many of these shoots measured from 12 to 18 inches in length.

Of the causes, or a cure for such a devastating attack, little can be said. A mild winter is generally reckoned a predisposing cause, but the winter of 1887-88 was not what might be called "mild." An analysis of the 61 days previous to the attack—that is, from the 1st of April to 1st June—shows that there were 18 days of frost, 2 on which snow fell, 20 on which rain fell, and 8 classed as cold or ungenial, thus leaving only 13 days of moderate temperature, or warm. June 5th was remarkably cold, and snow fell in Scotland and parts of England. Now this record is not consistent with the "mild season" theory. A writer, in noticing the attack of 1848 in the Forest of Dean, says, "There seems to be no method of checking their ravages. The rooks come in great numbers, and they and other birds destroy great quantities." But the report of the visitation of 1881 in the same forest says, "The very rapid and destructive nature of the blight this season may have been caused by the absence of large flocks of rooks, jackdaws, starlings, and other small birds, which have in previous years attacked the blight on its first appearance; and, as each bird will consume a large number of grubs daily, the plague was formerly much checked at the outset. The severe weather of last winter undoubtedly killed large numbers of these birds, and the caterpillar was consequently almost unmolested." In this statement it is curious to observe that in the writer's opinion the severe winter of 1880-81, although it killed the birds, could have had no effect on the insect, and this is another testimony against the theory of a mild winter. Of the five seasons in which the blight was prevalent, namely, 1831, 1848, 1864, 1881, and 1888, two were preceded by severe winters, namely, 1830 and 1880. As to birds being able to cope with this plague, I have to observe that in 1888 they forsook the woods entirely, and it was even said that the rabbits also did so. No living thing would care to be enveloped in such an annoying network of web.

Several species of the large family of *Geometrina*, or "measurers," so called from their progressing by looping themselves up and then extending their whole length as if measuring, are to be found on the oak, and assist the *Tortrices* in their depredations.

The other *Tortrices* besides the *Tortrix viridana* which infest the oak are—

Chloephora Prasinana.
,, *Quercana.*
Lozotænia Sorbiana.
,, *fulvana.*
,, *xylosteana* (common).
Ptycholoma Lecheana (common).
Hedya dealbana.
Dictyopteryx Læflingiana.
Pæcilochroma corticana.
Ephippiphora argyrana (on the bark).
Tortricodes hyemana (very common).

Of the *Deltoides* family only one is found on the oak, namely, *Herminia barbalis;* and of the *Crambites* there are three, namely,

Acrobasis consociella (not common).
,, *tumidella* (not common).
Nephopteryx Roborella (not common).

For further information on the subject of Lepidoptera the student is referred to "Stainton's Manual."

Of the several kinds of larvæ which are to be found affecting different parts of the oak tree, I have never found any in the acorn, nor do I find any record of such. This is to be noted, as very few seeds of plants escape the ravages of some variety of insect or another.

Fungi.

We now come to treat of the fungi that are to be found on the oak, but it is doubtful whether they can be properly classed as a disease, or only as the result of some other disease or of natural decay, for whenever they occur it is a certain sign of the bad condition of the tree.

Some tree fungi are not particular as to the tree upon which they grow, whilst others confine themselves to one genus or species.

The following may be taken as an approximate list of those found on different parts of the oak, some of which are to be found on other trees and substances :—

Galarilæus quietus, in oak woods.
Pleurotus dryinus, on the tree.
,, *palmatus*, on the tree.
Crepidotus aurant ferrugi, on the roots.
Coprinarius papyraceus, on the tree.
Dædalea quercina, on the tree.
Microporus frondosus, on the roots.
,, *sulphureus*, on the tree.
,, *hispidus*, on the tree.
Fistulina hepatica, liver-like or beef-steak fungus, grows on old trees in the New, Sherwood, and Epping forests, and is edible.
Hydnum minimum, on the rotten timber.
,, *erinaceus*, hedgehog fungus, is very rare and curious. Found in Epping Forest, and recently in the New Forest, by Dr M. C. Cooke, the eminent mycologist.
Merisma rubiginosa, on old trees.
,, *sinuans*, on the branches.
,, *quercina*, on fallen trees.
Helotium acicularis, on hollow trees.
Bulgaria inquinans, on dead trees.
Cenangium quercinam, on dead branches.
Exidia flaccida, on the bark.

Stromatosphæria parallela, on dead trees.
,, *nivea*, on dead branches.
,, *quercina*, on dead branches.
Cryptosphæria bifrons, on the dry leaves.
,, *punctiformis*, on dead leaves.
Sphæria biphæmia, on dead branches.
Phacidium coronatum, on dead leaves.
,, *dentatum*, on living leaves.
Hysterium pulicare, on the rugged bark.
,, *quercinum*, on dead branches.
Xyloma pezizoideum, on dead leaves.
Scleroderma citrinum, on the roots.
Erineum griseum, under the leaf.
Merulius rufus lachrymans, the dry-rot fungus, is perhaps the most to be dreaded, working in the timbers of buildings silently and unseen with fatal effect.

The fungi in their action on the trunks and fallen branches assist in the disintegration and decomposition of the wood, and finally to assimilate it again with the soil.

The *Lichens* which grow on the trunks and branches of most of our trees are an interesting study. They give to them a hoary and venerable appearance when the trees are

"Mossed with age."

The following are to be found on the oak, but of course there are many more which grow indiscriminately on the trunks and branches of it and other trees :—

Spiloma microclonum, on old trees.
,, *punctatum*, on old trees.
Lecidea carneola, on old trees.
Calicium microcephalum, on oak rails.
,, *hyperellum*, on old trees.
Thelotrema melaleucum, on young trees.
,, *hymenium*, on old trees.
Bæomyces cæspititius, on the tree.
Ramalina pollinaria, on old trees.
Verrucaria analepta, on the bark.
Sticta pulmonacea, liver-wort, which, when growing on the oak, is called "lungs of oak," and is supposed then to be specially efficacious in the cure of consumption and other diseases.

Historical and Remarkable Oaks.

Although other trees have their history and associations, the oak has been the historical tree of Britain, from the dark ages of the Druids until recent times, when it has become less the fashion to plant it as a memorial of the great, or in commemoration of any noteworthy event. How far this latter circumstance is wise, not to say patriotic, is open to question. Is any tree, whether native or foreign, except perhaps the yew, so fitting, in every respect, to tell future ages of what has been done, or to mark the progress of time, as the oak? I trow not.

Of oak trees remarkable for their historical associations we have the "Royal," the "Parliament," the "Shire," the "Gospel," the "Cheney Court," from the French *chenè*, an oak, and the "Bound Tree," marking the boundary of parishes or manors. In the same manner the name "Gospel" is derived from the ancient custom of treading the boundaries of parishes in "Rogation Week," when under an oak tree the Gospel for the day was read, and these trees have generally been preserved, but often under other names.

The Notable Oaks of England and Wales.

The following list has been compiled from various sources, and from personal observation; but it may here be remarked that some of the measurements given are imperfect or unreliable, the height from the ground where the girth is taken not being given with sufficient accuracy, in many cases, to enable one to compare it with other trees, and a girth at the ground is in most instances valueless when the tree is so buttressed with roots that almost any girth may be arrived at, consequently much room is left for exaggeration. On this point Mr Trowsdale says in the *Times*, "I would venture to express an opinion that local naturalists and antiquaries would render good service to the cause of literature were they to obtain, by personal measurement, the exact dimensions of the famous old trees now existing in their respective neighbourhoods." It is to be understood that in this record of remarkable trees they are all *Quercus robur pedunculata*, except where it is stated they are *Q. r. sessiliflora*. With this preliminary I now proceed with the list.

The Cowthorpe Oak, *Q. robur pedunculata*, whose age has been variously estimated at from fifteen to eighteen centuries, stands in the parish of Cowthorpe, three miles from Wetherby, in the West Riding of the county of York. The circumference of its trunk close to the ground was, at the close of last century, according to Evelyn's "Silva," 78 feet. Shortly after the publication of this work, earth was placed around the base of the trunk, with a view to the preservation of the tree, which by covering over some considerable projections reduced the girth of the stem at the ground line to 60 feet. In 1829 the Rev. Dr Jessop measured the tree, and communicated its dimensions to Strutt's "Silva Britannica," as follows:—

Circumference at ground,	60 feet.
" at 3 feet from ground,	45 "
Height of tree,	45 "
Extent of the principal limb,	50 "
Greatest circumference of principal limb,	8 "

Dr Jessop adds, "The tree is hollow throughout to the top, and the ground plot inside may possibly find standing-room for forty men." In Loudon's "Arboretum" the diameter of the hollow of the tree close to the ground is given at 9 feet 10 inches. This would give an area of over 96 square feet, which is certainly sufficient to afford standing-room for forty men.

In Dr Hunter's edition of Evelyn's "Silva," the dimensions are given—circumference at the ground, 26 yards (78 feet); height, 80 feet; and its principal limb 16 yards (48 feet) from the bole. This tallies so far with the other account, with the exception of the height of the tree.

The "Royal Oak" at Boscobel House in the ancient forest of Brewood, Staffordshire, has become celebrated in history for having given shelter to Charles II. after the battle of Worcester on September 6, 1651. The story is variously told. The Earl of Bradford, in a letter dated Weston Park, May 6, 1878, says, "On one occasion when he (that is, the king) was out with one or two of the Penderils, sounds were heard of horses' feet not very far off. There was not much time for consideration, but his attendants thought he might not be able to get back to his hiding-place in the house quietly, or perhaps thought that even if he did he might be discovered there, and recommended him to go into a thick part of the wood (being early in September, the trees and underwood were still in full leaf), where they helped him up into an oak tree (not a decayed, but a growing oak tree), and implored him on no account to come down from the tree until they returned to him and tell him all was safe. They then went as if to their work or ordinary occupation. The troopers of the Parliament fell in with them, made all sorts of inquiries about the house and its inmates and its neighbourhood, and ultimately rode on without discovering how near they were to the king. The Penderils returned in due time, and conducted the king back to the house."

The tree stands in a field near the garden of Boscobel house, and is surrounded by an iron palisading. It has a circumference, at 4 feet up, of 12 feet 3 inches. That the tree now standing is the same in which the king was concealed has been questioned, and that it is only a seedling from the "Royal," some authorities alleging that it is only 160 or 170 years of age, whilst others put it between 400 and 500. On this point it may be as well to quote again Lord Bradford's letter, and to mention that his seat of Weston Park adjoins Boscobel: he says, "The tree was from that time well known to them (that is, the Penderils), and doubtless to the owner, Mr Giffard, and other loyal friends in the immediate neighbourhood; and after the Restoration, which was only nine years afterwards, probably numbers of people visited the tree, although at that time in a thick coppice with only woodmens' paths or very bad cut roads in the neighbourhood. The coppice was subsequently cleared, I apprehend, in the time of the Fitzherberts, who inherited from the Giffards, but the tree into which the king climbed was left standing and regarded with pride and affection. It has been known from father to son by succeeding generations from that time to this. As to its being a substitute of any sort, least of all an acorn from the original tree, I discard the idea as ludicrous and absurd. I have known the tree myself for half a century.[1] It looks now very much as it did then; and nearly as long ago as that I remember my father speaking of the absurdity of the stories then current as to the owl flying out of the decayed tree, the present tree being an acorn from the old one, and such like. He used to say that he had heard his father, and, I think, his grandfather, speak in the same sense; and the recollection of the tree by his grandfather (my great-grandfather) would easily carry him back as far as 1740, which would be less than ninety years after the king sat in the tree."

[1] Earl Bradford was born in 1819.

"I may mention, with respect to oak trees and oak wood in this neighbourhood, that there are trees still alive in this park estimated to be 1100 or 1200 years old; there are others reckoned to be 600, 500, and 400 years old. Sometimes a smaller tree is known to be considerably older than a larger one, and I should myself estimate the tree at Boscobel to be 400 or 450 years old; but it would have been equally capable of affording a hiding-place for a man in the middle of a thick wood, whether it was then some 220 years old, as I estimate it, or whether it was 100 years younger or older."

Against this evidence as to its being the original "Royal" oak, another witness says "that he measured it in 1857, and again twenty-one years later, and found that its girth had increased 11 inches, or half an inch annually." In summing up the evidence for and against, it is necessary to bear in mind that the original tree was in a thick wood, and not a detached tree, or in any way conspicuous, which would have been sure to attract the attention of the Parliamentary troopers. Further, this wood seems to have subsequently been cleared by the Fitzherberts, the successors of the Giffards, but at what date is not stated. Now this fact would have gone far to establish the identity of the tree or otherwise, because, if the date of clearing or grubbing up of the wood was not long after the event, then it would be probable that the Fitzherberts knew the real tree, as they surrounded *a tree* by a brick wall; but if this took place very long after, then a doubt would still remain notwithstanding Lord Bradford's testimony, as the tree is certainly of small girth for say 450 years.

The "Parliament Oak" in Clipstone Park, Notts, is so called from an informal parliament having been held under it by King John, in 1212. Bailey says, "John this year perpetrated the enormous cruelty of putting to death, by hanging, at Nottingham Castle, twenty-eight youths belonging to the most illustrious families of Wales, which youths he had brought with him after the rebellion as hostages for the future peace and submission of the principality. At the time this event took place, the king was indulging himself in the pleasures of the chase at Clipstone Palace, when a messenger arrived from his sister Joan, who was married to Llewellyn, Prince of Wales, informing him of a fresh revolt, and at the same time another came with a letter from his friend and ally, David I., king of Scotland, apprising him of the existence of a widespread conspiracy against him in the northern parts of the kingdom. Hastily summoning a council of the barons and other distinguished individuals who were about his person or in the immediate vicinity of the palace, they met under the boughs of an oak tree in the park, which thence obtained the appellation of the "Parliament Oak." Another parliament is said to have been held here in 1290 by Edward I.

This tree stands in a nook by the side of the highway leading from Edwinstowe to Mansfield, at a point where that road is intersected by a private way of the Duke of Portland's. It has a circumference at 3 feet up of 28 feet 6 inches, but it is only a living ruin.

The "Greendale Oak" is, however, the most remarkable of the Welbeck oaks. It stands about half a mile south of the abbey, and is computed to be one of the oldest trees in existence in this country. The trunk having a century or two back become quite hollow with age, and so much decayed that large apertures occurred in its sides, the opening was, in 1724, sufficiently enlarged by cutting away the decayed wood, to allow an ordinary carriage to pass through, and it is said that one of its noble owners was actually driven through this opening with his bride, on the occasion of his marriage, in a carriage drawn by six horses. The height of the opening is 10 feet 3 inches, the width 6 feet 3 inches, and the circumference at the ground is 36 feet, above the arch 35 feet 3 inches, and the sheer height 54 feet.[1]

The "Shambles Oak" is another remarkable Welbeck tree. It is traditionally said that in its hollow trunk Robin Hood and his merry men used to hang up their venison as they would in a butcher's shop, until wanted, and that near it much of their cooking was done and revels kept. Some of the iron hooks are said still to be seen in the interior. It is said that, in later times, this notable tree was used by a sheep-stealer as a place wherein to hang his ill-gotten spoil until he could safely dispose of it. From these circumstances the tree acquired its name of the "Shambles Oak."

The "Two Porters," a pair of grand old trees, so called from

[1] The dimensions of this famous tree, accurately measured for the Royal Scottish Arboricultural Society by Mr Jameson, forester on the Welbeck estates, on the occasion of the Society's visit to it on the 7th August 1889, are as follows:—height, 45 feet; girth, 31 feet at the base, and 30 feet at 5 feet up; the opening in the tree, 9 feet 1 inch high, by 7 feet 3 inches wide on the east, and 5 feet 4 inches on the west side.—Ed.

there having been once a gate between them. They stand nearly at the north extremity of the park, not far from the south lodge of Worksop Manor, and the drive passes between them. They measure as follows:—circumference at the bottom, 38 feet; at 3 feet up, 27 feet; and at 6 feet up, 23 feet; sheer height, 98 feet 6 inches. The other has a circumference at the bottom of 34 feet; at 3 feet up, 23 feet; and at 6 feet up, 20 feet; sheer height, 88 feet. These oaks are *Quercus robur sessiliflora.*[1]

The "Seven Sisters" so called from having consisted originally of seven stems springing from one common root, is one of the most remarkable trees anywhere in existence. Some of the "sister" stems have, from time to time, been blown down, but it is still a noble tree. It is situated about half a mile from the "Two Porters." The circumference of the common trunk, close to the ground, is over 30 feet, and the height 88 feet. The measurements of the "Seven Sisters" were given nearly a century ago, as follows:—in height it is 88 feet 7 inches; the circumference at the bottom is 30 feet; at two yards, taking in the stems, 30 feet 4 inches. The largest stem at two yards is 12 feet 10 inches in circumference; another at the same distance from its bottom is 11 feet 7 inches; one, 9 feet 10 inches; and the smallest, 5 feet 3 inches in circumference.[2]

The "Queen Oak," now called the "Major Oak," so named, it is said, after Major Hayman Rooke, who often visited it, and wrote much on the forest; it was also called the "Cock-pen Tree," from its hollow interior being occupied as a hen-roost. The hollow is nearly 7 feet in diameter and 15 feet high. A considerable portion of its tendons appear above ground, and measuring these about halfway between their junction with the trunk and their insertion in the earth, they gave a circumference of nearly 30 yards; the circumference of the trunk at nearly 6 feet from the ground, the height at which begin the branches,

[1] On the occasion of the Society's visit in 1889, the "Two Porters" were measured, and the dimensions are given in the Report of the Excursion as follows:—No. 1 girths at base 36 feet 8 inches, and at 5 feet up 25 feet 8 inches; and is about 24 feet high, having been broken off by a storm in 1881. No. 2 girths at base 36 feet, and at 5 feet up 23 feet 2 inches; and stands about 60 feet high.—Ed.

[2] The last of the "Seven Sisters" was blown down about a year previous to the Society's visit on the 7th August 1889, so that this famous tree is now a thing of the past.—Ed.

was 30 feet, at 4 feet the circumference is 29 feet, and the sheer height 80 feet.[1]

The "Ruysdael Oak," so named by a late Duke of Portland, because it resembled in shape those peculiarly formed trees which that great painter delighted to introduce in his pictures. It stands on a commanding eminence in the park, not far from the "Seven Sisters," and forms a striking object from whichever side it is seen, notably from the mansion itself.[2]

The "Simon Forester" oak is another of the famous trees in Sherwood Forest, with a circumference of 22 feet and a height of from 50 to 60 feet.

Such are some of the notable old trees of "Sherwood Forest" which have received names, but although now no longer a royal forest, there still exist many other grand old oaks that date back to times when this great forest was the hunting-ground of kings.

We now come to the oaks in Windsor Park.

The "Cow Pond Oak" may be first noticed, as it is one of the few trees of which we can fix the date of planting with any accuracy. The account is, "About the year 1718 the plantation lying between Cumberland Lodge and Cow Pond was formed, and we mention it simply because it contains what is generally considered to be the most perfect timber tree in Windsor Park. It has a straight clean bole over 40 feet up to the first branch, with a girth of 10 feet 4 inches at 5 feet from the ground; now, taking the age up to 1880, would be 162 years, this would give an annual increase in circumference of ·765 inch.

"Herne's Oak." This tree or trees, for it appears there were two claiming the honour of being the tree immortalised by Shakespeare in the "Merry Wives of Windsor"—

> "There is an old tale goes, that Herne the Hunter;
> Sometime a keeper here in Windsor Forest,
> Doth all the winter-time, at still midnight,
> Walk round about an oak, with great ragg'd horns;
> And there he blasts the trees, and takes the cattle,
> And makes milch kine yield blood, and shakes a chain
> In a most hideous and dreadful manner."

[1] In the Report of the Society's Excursion in 1889, the dimensions of the "Major Oak" are given as—girth, 29 feet 6 inches at 5 feet up; height, 60 to 70 feet; spread of branches, 90 feet.

[2] "Gaunt and dead at least fifteen years, but it still defies the blast and maintains an upright position" (Report of Society's Excursion, 1889).—Ed.

Some years ago a sharp controversy was carried on as to the identity of "Herne's Oak," it being contended by some authorities that it was cut down in error, during the reign of George III., about the year 1796; the other "Herne's Oak" was blown down in 1863, but as the Queen has planted one in its place, this will perpetuate the name. It stood in the Home Park, but I cannot find what were its dimensions.

"Queen Elizabeth's Tree," so called from having been said to have been a great favourite of the virgin Queen. It stands close to the site of "Herne's Oak."

"Shakespeare's Oak," another tree supposed to have been the great poet's favourite oak, stands close by the last; both are said to be fine trees, but in neither case have we got dimensions.

"William the Conqueror's Oak." Beyond the fact that this tree has been associated with the Norman's name from time immemorial, its history is unknown. The main stem has long been decayed, and is supported with props. It is situate near Cranbourne Lodge, just within the park palings, and is, consequently, but little seen by the public. It has a circumference of 37 feet at 5 feet up.

The "Forest Gate Oak" is an old pollard, with a circumference of 28 feet 4 inches.

"Queen Anne's Oak" has a circumference of 15 feet 3 inches at 5 feet up, and is 60 feet high.

"Queen Charlotte's Oak" has a circumference of 17 feet 3 inches at 5 feet up, and is 65 feet high.

"Queen Victoria's Oak" is perhaps as handsome a specimen of a thriving young oak as it would be possible to find. It has a magnificent straight stem 38 feet up to the first branch, and a beautifully rounded head. It was chosen by Her Majesty as her favourite oak soon after her accession. It is 11 feet 11 inches in circumference at 5 feet up, and is 70 feet high.

The three last-mentioned "Queen" oaks are in the forest between Highstanding Hill and New Lodge.

The "Prince Consort's Memorial Oak," planted by Her Majesty on November 25, 1862, marks the spot where her much-loved husband finished his last day's shooting on November 23, 1861.

Before taking leave of Windsor, it may be as well to notice the plantation, containing a large group of oaks, stretching from the back of the park bailiff's house in the direction of Cranbourne Walk. It is supposed that allusion is made to this plantation of

14 acres in a document of the year 1625, which had been fenced with pales into the Great Park, and sown with acorns in 1580. These trees, at the present time, are of a singularly uniform character, and perfectly healthy. This is supposed to be the earliest authenticated record of any regular plantation known to have been made in England. They number about twenty-one to the acre, and their average content is about 88 feet. In addition to this, it would be desirable to have more details as to the size of individual trees, as this would be a contribution towards solving the question of "raising forests from seed."

The "New Forest" in Hampshire, although of large extent, has few oak trees of interest. They do not grow so high or so large as in many other parts of England, but they are more picturesque in their outlines, appearing in the distance as if suspended in the air rather than growing out of the earth.

The "Western Oak" at Boldrewood has a circumference of 24 feet 9 inches.

The "Eastern Oak," at the same place, has a circumference of 16 feet.

The "Northern Oak," also at Boldrewood, has a circumference at the thickest part of 20 feet 4 inches; lower down it is only 14 feet 8 inches.

The "Knyghtwood Oak" has a circumference of 17 feet 4 inches.

The "Moyle's Court Oak" is a handsome tree, standing a few yards outside the "Forest" boundary. It has a circumference of 18 feet 8½ inches.

The "Cadnam Oak" is remarkable in that it puts forth young leaves on Old Christmas morning, which fact seems to be well attested. A description of this tree appeared in *Woods and Forests*, February 1885, the writer of which, after a graphic account of his visit to it on Old Christmas morning in that year, says, "perhaps some of your correspondents may know of such in other parts of England;" but to this there was no response, so it may be presumed that this oak is unique. It stands some 10 yards to the north of the Southampton Road, where that to Ringwood crosses it, by the fence of Widow Gain's garden, and has a circumference of 10 feet 6 inches at 4½ feet up, a bole of 17 feet, and a height of 55 feet. It is apparently a young tree, although a good part of the south side of the whole length of the trunk is gone, which is, however, being fast covered over by the growth of the tree, although it is still from 1 foot to 18 inches broad.

"Oakley Oak" is situated in a meadow to the east of Oakley farm-house, from which it is separated by a branch of the river Test, leading to the grounds of Mottisfont Abbey in Hampshire. It has a circumference of 31 feet 6 inches at $4\frac{1}{2}$ feet up; at 9 feet it branches into six large but hollow limbs, where, owing to the swell of its branches, the circumference is much larger; the sheer height is 27 feet. The living branches are comparatively young, and they put forth leaves and bear acorns freely. The trunk is quite hollow, and has a cavity measuring at the ground 9 feet by 9 feet in diameter, and at $4\frac{1}{2}$ feet up 7 feet by 7 feet, which is the smallest diameter of the hollow trunk. The entrance to the interior is on the north side, and is 3 feet 7 inches high, and 1 foot 8 inches wide. The hollow limbs admit plenty of light into the interior.

"Seven Yards Oak." This is an old tree, showing signs of decay, and although apparently sound in the trunk, it does not look so healthy as the "Oakley Oak." It stands in Hurstbourne Park, belonging to Lord Portsmouth, near Whitchurch in Hampshire, and on the boundary between the parishes of Hurstbourne Priors and Whitchurch. It is not known how long it has borne the name of "Seven Yards," but 21 feet is still the circumference at $4\frac{1}{2}$ feet up.

"Canon Beadon's Oak." I notice this tree because its history is given as follows:—"This oak was planted by the late Canon Beadon in North Stoneham Rectory grounds, near Southampton, when home from school, at the age of fourteen years, the same having been raised from an acorn in a flower-pot by his sister. The Rev. Canon died June 10, 1879, having lived to sit under this oak, now a considerable tree, and witnessed a cricket match when he had attained his one hundredth year, the tree being then eighty-six years of age. The circumference is 11 feet 3 inches at $4\frac{1}{2}$ feet up.

"Dean Forest" is another Royal Forest, and although not so large as the "New Forest," is not without some notable trees, viz.,—

"Jack of the Yat," which is probably the oldest within the present bounds of the "Forest," stands by the roadside near the 16th milestone on the Long Hill. In 1830, it measured 17 feet $8\frac{3}{4}$ inches at 6 feet up; in 1846, 18 feet $3\frac{1}{2}$ inches; but in 1881, it was only 18 feet $\frac{1}{4}$ inch. This discrepancy can hardly be accounted for.

The "Crad Oak" is a fine specimen of *Quercus r. sessiliflora*, in flourishing condition. It stands back in the woods behind "Jack." That is all the information we have respecting this "fine specimen," but it is certainly desirable that something should be known of its dimensions, as so few trees of this species of oak are recorded.

The "Newland Oak" stands outside the present Dean Forest, but within the ancient forest bounds, and is a large old tree, measuring 41 feet round the trunk, and being probably one of the oldest and largest oaks in the kingdom. Another account says, "Its trunk is not buttressed at the base, and the girth of 52 feet at the ground is scarcely lessened up to 12 feet, where five grand primary branches spread out from the hollow bole, divaricating into more than fifteen.

The "Colwall Oaks." In the parish of Colwall, near the old hunting-seat of the bishops of Hereford, is a good-sized fish-pool, and near this pool, in the middle of a pasture, stand these trees, supposed to be the two oldest oaks anywhere about the Malvern Hills, showing undoubted evidences of very great antiquity. The largest has been much shattered and lost some of its finest branches, so that at a distance it has a lank and attenuated look. The extreme base of the trunk bulges out considerably, and is more than 60 feet in circumference; but this diminishes so quickly that at a yard from the ground it girths only 27 feet. The companion oak to the great one, and almost as old, girths 45 feet round the swollen base.

The "Old Pollard Oak." In the southern part of Malvern Chace, in a field near the Severn, stands this tree, putting out horizontal arms in a very curious manner. It is a characteristic specimen of what is called a "burr oak," of which many may be seen in the neighbourhood, the result of pollarding from time to time. The circumference at 3 feet up is 17 feet.

The "Devil's Oak." This tree has assumed a demoniacal shape, the result also of pollarding, and presents a most grotesque appearance. It is said, however, that the appellation was really given to it from some sweeps having been seen to emerge in the mist of an autumnal morning from its cavity, where they had been sheltering, and as they disappeared in the fog, were very like imps of the evil one. The name, at all events, is likely to stick to the deformed tree. It stands in a hedge by the side of the road leading to Sherrard's Green, below Great Malvern.

The "Cowleigh Oak" is the most conspicuous tree in Malvern Chace for size and spread of bough. It is called "Cowley's Oke" in a MS. Survey of Malvern Chace, A.D. 1633, and stands near Great Malvern, in the middle of a pasture next to Cowleigh farm-house. It has a circumference of 27 feet at 3 feet up.

The "Great Burr Oak" is another remarkable tree, the result of pollarding, and which has hardly any trunk. It stands on the banks of the Teme in the parish of Leigh, about a mile west of Bransford Bridge, and has a circumference of 20 feet at 3 feet up.

The "Gibbet Oak" is supposed to derive its name from having been used as the place for hanging spies and traitors in the Wars of the Roses. It stands on a gentle eminence at short distance from the Tenbury and Bromyard main road in Kyre Park, Worcestershire. It measures 24 feet in girth at 5 feet up, and its huge and widely-extended arms, standing out at right angles some 8 feet or 9 feet from the ground, seem to be well adapted for the use then made of it.

The "Weeping Oak" at Moccas Court, Herefordshire, was considered by Loudon to be one of the most remarkable oaks in England. "The branches reach from about the middle of a trunk of 75 feet to within 7 feet of the ground, hanging down like cords, and many to a length of 30 feet, having a thickness which does not in any part of them exceed that of a common waggon rope. The entire head covers a space of 100 feet in diameter.

The "Weeping Oak" at King's Acre, Hereford, was planted in 1785 by a Mr Cranston, and grafted at about 3 feet from the ground. The girth of the trunk at 4 feet up is 8 feet 6 inches; height to the lowest branch, 18 feet; spread of branches, 58 feet; and the sheer height, 72 feet.

The "Coronation Oak," so called from the proclamation being announced therefrom on a king or queen being crowned. The coronation of Queen Victoria was announced from under the spreading boughs of this grand old tree. It stands in one of the meadows on the farm of Llanhenosk, near Caerleon, Monmouth. The circumference of the trunk in its largest part is 38 feet 6 inches; in the middle, 32 feet $1\frac{1}{2}$ inches; and the smallest, 27 feet 6 inches: the bole is 15 feet in height.

The "Pencraig Oak" is on Pencraig Farm near Newport, Monmouth. It has a circumference of 38 feet; height to first branch, 15 feet, with a spread of branches of 36 yards.

The "Cressage Oak," or "Christ's Oak," under which it is said the early Christian missionaries, and possibly St Chad himself, preached to the heathen before churches had been built, is the sole remaining tree of those vast forests which gave Shrewsbury its Saxon name of Schobbesburgh. It stands in an arable field on the banks of the Severn, half a mile from Cressage in Shropshire. It has a circumference of about 30 feet at 5 feet up, although only about one-half of the shell of the hollow trunk now remains, but it has still fifteen living branches, each 15 feet or 16 feet in length.

The "Beggar's Oak" grows in Lord Bagot's park, in North Staffordshire, and is said to be one of the most picturesque trees in England. The head is round and full of foliage, drooping almost to the height of a stag, and offering a welcome shelter either in the heat of a summer day or during a storm. The circumference above the swell of the spurs is 27 feet 3 inches, and at 5 feet the girth is 23 feet 2 inches; the branches extend from the trunk 50 feet in every direction, and the height is 60 feet.

The "Squitch Oak" is also in Lord Bagot's park, has a circumference of 23 feet 2 inches at 5 feet from the ground.

The "King Tree" is another noted tree in Lord Bagot's park. It was considered when sound to be the most valuable oak in the park, which is celebrated for its numerous splendid oak trees, and was valued in 1812 at £293. It has a circumference at 5 feet up of 20 feet, and runs up without a limb to 30 feet, with a sheer height of 70 feet.

The "Venison Tree" is supposed to be the oldest tree in Bagot's Park, and in existing records is shown to have been a tree of note upwards of six hundred years ago.

The "White Tree," in the same park, so called from its variegated leaves, which are blotched with white, has a very remarkable appearance in contrast with the dark green foliage of its neighbours.

The "Swilcar Lawn Oak" grows in Needwood Forest, Staffordshire, and towers above all others. It has been poetically named the forest's "chief mourner." It has a circumference of 27 feet at 5 feet up.

The "Oaks of Caulke Abbey," Derbyshire. No. 1 girths 25 feet 3 inches above the swell of the roots, and is 75 feet high. No. 2 is a fine tree, girthing 18 feet at 1 foot up, and is 60 feet high. No. 3 girths 20 feet at 1 foot up, and has scarcely any taper for a height of 30 feet, is in vigorous health, and a fine timber tree. No. 4 is in a glen near the Monk's Cave. It girths at the top of the trunk, which is 12 feet long, 28 feet, and at the bottom 31 feet.

The "Queen's Oak" grows at Grafton, Northamptonshire. Sir John Grey of Groby, who fell at the battle of St Albans, being a zealous Lancastrian, his estates were forfeited by the victorious Edward, and under this oak, according to tradition, his widow first met Edward IV., whom she had sought to implore the restitution of her slain husband's forfeited estates. Edward was captivated with her person and manners, and finding her virtue inflexible, was married to her, though the marriage was not proclaimed till some months afterwards. This lady's name was Elizabeth Wideville, daughter of Richard, Earl Rivers, and the first British lady subsequent to the Norman Conquest who shared the throne of her sovereign. The hollow trunk has a circumference of 22 feet at 5 feet up.

The "Yardley" or "Cowper's Oak," also called "Judith," from an old legend that it had been planted by the Conqueror's niece Judith, Countess of Northumberland, who held eighty-eight manors in Northamptonshire, including a portion of Yardley. On the tree is fastened this warning—"Out of respect to the memory of the poet Cowper. The Marquis of Northampton is particularly desirous of preserving this oak. Notice is hereby given that any person defacing or otherwise injuring it will be prosecuted according to law." The tree is a ruin, with a hollow trunk broken through below, and capable of holding many persons. There are two or three bare limbs, from which the bark has fallen, showing like whitened skeletons against the lichened and knotted rind of the trunk, and there are at least two large boughs which still send out their clusters of green leaves. The circumference is 30 feet 6 inches at 1 foot up, and 30 feet at 3 feet up.

The "Bull Oak," in Wedgenock Park, Warwick, was a remarkable tree, now only a ruin, with a butt 18 feet in diameter at the ground. Growing from among its roots is a beautiful ash tree.

In Stoneleigh Park, Warwick, near the Abbey, there are many fine oaks. One has a circumference of 24 feet, and is a perfect model of an oak. Another in the Deer Park has a circumference of 36 feet 9 inches.

"King Charles' Oak," in Blenheim Park, Oxfordshire, is a very fine tree, with a circumference of 23 feet, a bole of 23 feet, and contains 765 feet of timber.

The two "Ampthill Oaks" grow in Ampthill Park, Bedfordshire. This park extends over the sides and summit of the rising ground, and its sweeping glades and hollows, with much wood of later growth, display a greater number of venerable oak trees than, perhaps, any other park in England of the same extent. On one of the two trees the following verses are fastened :—

> "Majestic tree, whose wrinkled form has stood,
> Age after age, the patriarch of the wood;
> Thou who hast seen a thousand springs unfold
> Their ravelled buds, and dip their flowers in gold,
> Ten thousand times yon moon relight her horn,
> And that bright star of evening gild the morn.
> Gigantic oak! thy hoary head sublime,
> Erewhile must perish in the wreck of time.
> Should round thy head innoxious lightnings shoot,
> And no fierce whirlwind shake thy steadfast root;
> Yet shalt thou fall, thy leafy tresses fade,
> And those bare scattered antlers strew the glade.
> Arm after arm shall leave the mouldering bust,
> And thy firm fibres crumble into dust.
> The muse alone shall consecrate thy name,
> And by her powerful art prolong thy fame,
> Green shall thy leaves expand, thy branches play,
> And bloom for ever in the immortal lay."

This provoked the following retort from Lord Wensleydale :—

> "I'll bet a thousand pounds—and time will show it—
> That this stout tree survives the feeble poet."

The two trees stand at a short distance from the mansion, and are nearly of the same girth, namely, a little over 35 feet at 3 feet up.

"Queen Elizabeth's Oak" stands in Hatfield Park, Hertfordshire. "On the morning or afternoon of November 17, 1558, for Mary died between 4 and 5 A.M., Elizabeth was sitting under this tree, when a deputation arrived from the council to apprise her of her sister's demise and to offer her their homage. She fell on her knees, and exclaimed in Latin, *Domino factum est illud, et est mirabile inoculis nostris*, 'It is the Lord's doing, and it is marvellous in our eyes.'" It stands half-way down the avenue leading from the house towards Hertford. It is surrounded by a fence, and is not in vigorous health, or of a very remarkable bulk. We have no measurements of this historical tree.

The "Lion Oak" stands also in Hatfield Park, and has a circumference of 32 feet.

The "Grimston Oak" was planted by James, second Viscount Grimston, who died in 1773. The tradition is that Lord Verulam's great grandfather planted this tree with his own hands some twenty years before his death, so that it would now be over one hundred and thirty years. It stands a few yards from Oxhey Chapel, about 2 miles from Watford, Hertfordshire, and has a circumference of 17 feet and a bole of 24 feet.

Two "Pollard Oaks," in Moor Park, Hertfordshire, girthing 23 feet and 25 feet respectively; said to have been pollarded or beheaded in 1686 by the Duchess of Monmouth in revenge for the execution of her husband.

The "Winfarthing Oaks" stand in the parish of Winfarthing, Norfolk. No. 1 has been long known as the "Winfarthing Oak." Robert Marsham measured this tree in 1744, and gives the circumference as 38 feet 7 inches. Mr Geo. Southwell measured it in 1874, when it had a circumference of 40 feet, giving an increase of 17 inches in 130 years. No. 2 was measured in the same years by the same gentlemen, and had a circumference in 1744 of 30 feet, and in 1874 still only 30 feet, having remained *in statu quo.*

"Wilberforce's Oak," at Holwood, Kent, so called from the great philanthropist who brought about the abolition of slavery. The following words, from his diary of the year 1788, are engraved on a stone chair which Earl Stanhope set up close to this historic tree in 1862; they are, "At length I well remember, after a conversation with Mr Pitt in the open air at the root of an old tree at Holwood, just above the steep descent into the vale of Keston, I resolved to give notice on a fit occasion in the House of Commons of my intention to bring forward the abolition of the slave trade." This tree has a circumference of 18 feet 1 inch at 3 feet up, and 18 feet 3 inches at 5 feet up.

"Pitt's Oak," at the same place, perpetuates the name of the great statesman. He used to sit and read underneath its spreading branches. It stands near Holwood House, and has a circumference of 20 feet 1 inch at 3 feet up, at 8 feet up it divides into four massive limbs and spreads its branches 57 feet, the sheer height being only 36 feet.

The "Two Oaks" in Cowdray Park, Sussex. No. 1 was measured in 1819, and had a girth of 20 feet at 1 foot up, which was increased to 28 feet in 1879; at the same date it had a girth of 19 feet at 5 feet up; sheer height about 80 feet. No. 2 had a circumference in 1879 of 19 feet 2 inches at 5 feet up, and a sheer height of 90 feet.

"Miss Maury's Oak" has been long spoken of as an object of interest, especially on account of the loving care and the value attached to it by its aged owner. It is not a large nor a very old tree, but is remarkable for its symmetrical proportions and finely-developed head. It stands in a paddock in front of the old farm-house in the parish of West Wellow, Wiltshire, and has a circumference of 16 feet 9½ inches at 4½ feet up; a bole of 9 feet to where ten large boughs had sprung from the parent stem, now only five, some of them 2 feet in diameter; the sheer height is 90 feet, and it spreads its branches from east to west 36 yards, and from north to south 33 yards.

"No Man's Oak," or the "Forest Tree," is a striking object, standing on an elevated ridge at the northern boundary of the New Forest. Its knotted and gnarled trunk and bare arms, but scantily clothed with ivy, give it a weird-like appearance, as it stands alone without a companion living or dead. It is, however, quite dead, but is to all appearance sound timber, and it is difficult to account for its death. The place is named "No Man's Land," and here the counties of Hants and Wilts are divided by a bank and ditch which are wholly in Wilts, and on the bank stands the tree, about 4 feet within the county. It has a circumference of 10 feet 6 inches, and a bole of 10 feet.

The "Longleat Oak," at the Marquis of Bath's Wiltshire seat, has a circumference of 25 feet 6 inches at 5 feet up.

"Penrhyn Castle Oaks," Caernarvonshire, of which there are two to be noticed, are standing near the castle. No. 1 girths 10 feet 1 inch at 3 feet up, with a length of bole of 50 feet. No. 2 girths 10 feet 10 inches at 3 feet up, 9 feet 7 inches at 5 feet up, with a length of bole of 43 feet.

Although tradition reports some large trees which were in existence in ages past, both in England and Wales, the accounts relating to them are no doubt in many cases considerably exaggerated; still the measurement of some of them are sufficiently authenticated to warrant the conclusion that there are none at present in existence so large as some of the giants of old, as for example, the "Golynos Oak," which grew about four miles from the town of Newport in Monmouthshire, which was felled in the year 1810 for the use of His Majesty's navy, and contained the large quantity of 2426 cubic feet of sound convertible timber. It was bought standing for £405, and the whole produce of the tree, when brought to market, was within a trifle of £600. Now, no tree is in existence which approaches this in size and soundness, and I have given an account of it because the particulars are well authenticated.

The Notable Oaks of Scotland.

Scotland cannot boast of such giant oaks as are found in England and Wales, but there are many remarkable old oak trees scattered over the northern country; and the following description of some of the more notable is taken from "Forestry," the *Transactions* and *Reports of Excursions of the Royal Scottish Arboricultural Society*, Hunter's "Woods and Forests of Perthshire," and various other publications.

The "Wallace Oaks," for there are two associated with the name of Scotland's great patriot. The one at Torwood, Stirlingshire, had a girth of 22 feet in 1771. The other one is at Elderslie, Renfrewshire, the birthplace of Wallace. It has a girth of 21 feet at the ground, 13 feet 2 inches at 5 feet up; height, 67 feet; and its branches extend 45 feet east, 36 feet west, 30 feet south, and 25 feet north. Wallace and three hundred of his men hid themselves from the English among the branches of this tree, which was then in full leaf. It is said to cover 19 poles of ground, but, according to the above measurements, it would not appear to cover quite 13 poles, taking it as a circle, and even taking the space covered as a square, would only be over 16 poles.

Of the "Inveraray Oaks," one is growing in the grounds of Inveraray Castle, Argyllshire, and has a girth of 12 feet 11 inches at 5 feet up, a straight clean bole of 20 feet, and a height of 96 feet. No. 2 is at the Dhu Loch avenue, and girths 12 feet at 5 feet up. No. 3, at the same place, girths 11 feet 7 inches at 5 feet up. No. 4 is close by the Aray stream, with a girth of 12 feet 4 inches at 5 feet up. No. 5 is on a sloping bank at Maam, and girths 12 feet 2 inches at 5 feet up, and attains a height of 50 feet.

On the north side of Loch Arkaig, in Lochaber, Inverness-shire, there is an oak with a circumference of 27 feet 6 inches at 4 feet up.

The "Darnaway Forest Oaks," Morayshire. No. 1 is on a rising ground forming the centre of a little clearing. It girths 11 feet 6 inches at 1 foot up, 9 feet 3 inches at 5 feet, a bole of 15 feet, and a spread of branches of 80 feet. No. 2 is in the Haugh of Logie, with a girth of 13 feet 9 inches at 1 foot up, 11 feet 5 inches at 5 feet, a clean bole of 23 feet, and a spread of branches of 75 feet. The following are also situate in the "Haugh," and, according to Sir Thos. Dick Lauder, this grove, previous to the great flood in August 1829, when many of the trees growing nearest the river were washed away, contained the finest oaks in Scotland. No. 3 has an irregular gnarled stem, girthing 23 feet at 1 foot up. No. 4 girths 27 feet 9 inches at 1 foot up, and 20 feet 5 inches at 5 feet up. No. 5 girths 20 feet 6 inches; No. 6, 20 feet 5 inches; No. 7, 18 feet 8 inches; No. 8, 17 feet 1 inch; No. 9, 16 feet; No. 10, 14 feet—all at 5 feet up.

An oak on the banks of the romantic Findhorn, on the Altyre estate, Morayshire, has a circumference of 16 feet 7 inches at 1 foot up, 13 feet 3 inches at 5 feet up, and spreads its branches 100 feet.

The "Drummond Castle Oaks," Perthshire. No. 1 grows by the side of the burn to the east of the castle—it girths 19 feet 6 inches at 1 foot up, 14 feet 8 inches at 5 feet up; length of bole, 12 feet; a height of 70 feet; and a spread of branches of 114 feet. No. 2 adjoins the last, and girths 13 feet 4 inches at 1 foot up, 10 feet 1 inch at 5 feet up; length of bole, 14 feet; height, 81 feet; and spreads its branches 77 feet. No. 3 also adjoins, and has a girth of 10 feet 10 inches at 1 foot up, swelling out to 15 feet 8 inches at 5 feet up; length of bole, 11 feet; and the height, 45 feet. There are two fine oaks at the south end of the loch. No. 4 girths 18 feet 7 inches at 1 foot up, 11 feet 10 inches at 5 feet up; length of bole, 21 feet 6 inches; height, 78 feet 6 inches; and a spread of branches of 100 feet. No. 5 girths 14 feet 3 inches at 1 foot up, 11 feet at 5 feet up; length of bole, 17 feet; height, 64 feet; and spreads its branches 73 feet. No. 6 grows by the side of the walk circling round the south side of the gardens—it girths 14 feet 4 inches at 1 foot up, 10 feet 9 inches at 5 feet up; length of bole, 26 feet; and a height of 96 feet. No. 7 is a gnarled old tree by the side of the burn east of the castle—it girths 17 feet 4 inches at 1 foot up, 17 feet 7 inches at 5 feet up; length of bole, 9 feet; and a height of 66 feet.

The "Lawers Oaks," of which there are two, near the ruins of the chapel at Lawers, near Comrie, Perthshire. No. 1 girths 20 feet 8 inches at 1 foot up, and 13 feet 5 inches at 5 feet up. No. 2 girths 20 feet 7 inches at 1 foot up, and 12 feet 6 inches at 5 feet up.

The "Ochtertyre Oaks," at Ochtertyre, near Crieff, Perthshire.

"By Ochtertyre there grows the aik."

In a group by the margin of the loch is an oak girthing 18 feet 1 inch at 1 foot, 16 feet 2 inches at 5 feet up, with a length of bole of 12 feet.

"Eppie Callum's Oak" stands at the corner of the road leading to Messrs Morgan's saw-mills at Crieff. It is said to have been raised in a tea-pot by "Eppie," and then planted out. It has a girth of 16 feet at 3 feet up, and is a grand tree.

The "Pepperwell Oak" grows near Methven Castle, Perthshire, so called from being near a well of that name. It girths 23 feet at 1 foot up, 19 feet 6 inches at 5 feet up, a height of 80 feet, and spreads its branches 90 feet.

"Malloch's Oak" is on the Strathallan Castle estate, near Auchterarder, Perthshire, and is supposed to be a remnant of the ancient forest which once covered this part of the country. It is supposed to be about six hundred years old, and served as a gallows for a man who was hanged by the rebels in 1745. It has a girth of about 16 feet.

"James VIth Oak," situate at Scone, near Perth, is a fine specimen, said to have been planted by "King Jamie." It girths 15 feet at 1 foot up, 13 feet 3 inches at 5 feet, and a height of 55 feet.

At Seggieden, a few miles below Perth, in the Carse of Gowrie, there is an oak which girths 16 feet at 1 foot up, 13 feet at 3 feet, 12 feet 1 inch at 5 feet, 11 feet 6 inches at 20 feet, and 11 feet 8 inches at 22 feet; with a clean straight bole of 28 feet, a total height of 70 feet, and spreads its branches 90 feet.

"Birnam Oak" grows near to Birnam, Perthshire, and close to the river Tay. This tree is popularly believed to be one of the remains of "Birnam Wood" of Shakespeare's "Macbeth." It girths 23 feet at 3 feet up, 19 feet 7 inches at the narrowest part of the bole, has a total height of 50 feet, and spreads its branches 40 feet.

An oak at Dunkeld, Perthshire, near what is considered to be the first larches introduced into Scotland, has a girth of 12 feet

6 inches at 5 feet up, a fine bole of 30 feet, and a total height of about 100 feet.

The "King's Park Oak," at Dunkeld, on the Athole property, has a circumference of 15 feet $8\frac{1}{2}$ inches at 3 feet up, 15 feet 2 inches at 4 feet, the narrowest part of the bole. It has a fine bole 12 feet in length, which branches into five huge limbs the size of ordinary trees. The spread of branches is 99 feet.

The "Murthly Castle Oaks," Perthshire. No. 1 has a girth of 18 feet at 5 feet up. No. 2 has a girth of 10 feet 4 inches at 5 feet up.

The "Taymouth Oaks" grow at Taymouth Castle, Perthshire, and were planted in 1842 by Her Majesty the Queen and Prince Albert. They were measured in 1884—one had a girth of 4 feet 9 inches at 3 feet up, and a height of 45 feet.

An oak close to the public road between Weem and Fortingal in Perthshire has a girth of 15 feet at 1 foot up, and 12 feet 6 inches at 5 feet.

The "Dalgety Oak" grows in Dalgety parish, Fifeshire, on the north shore of the Firth of Forth. It has a girth of 13 feet 10 inches at 1 foot up, 11 feet at 5 feet up, a length of bole of 48 feet, and a total height of 90 feet.

An oak at Hillhouse of Luss, on the shore of Loch Lomond, Dumbartonshire, girths 12 feet 10 inches at 5 feet up, and has a bole 20 feet in length.

The "Inchmurrin Oaks" grow on that island in Loch Lomond. They were measured by Sir Thos. Dick Lauder in 1784, but since which time there does not appear to be any record of them. No. 1 stands in the middle of the island, and measured at the above date 18 feet 1 inch in circumference. Its head was remarkable for its great leafy expanse. No. 2 girths 20 feet 8 inches at 3 feet up. No. 3 girths 28 feet 5 inches, also at 3 feet up.

The "Blairquhoish Oak," Strathblane, Stirlingshire, has a girth of 15 feet at 4 feet up, and a spread of 30 yards.

An oak at Hopetoun, Linlithgowshire, had a circumference of 10 feet in 1855, which had increased to 11 feet 9 inches in 1880, or 21 inches in twenty-five years. The total height was 106 feet in 1855, and 110 feet in 1880, being an increase of 4 feet.

The "King of the Forest" grows on the top of a high steep bank overhanging the North Esk river in the old Caledonian Forest at Dalkeith, Midlothian. This remnant of the old forests of Scotland extends to about 160 acres. The "King" has a circumference of 18 feet 2 inches at 2 feet up, 15 feet 3 inches at 5 feet up, a length of bole of 20 feet, and a total height of 90 feet.

An oak at Penicuik, Sir Geo. D. Clerk's, Bart., seat in Midlothian, has a circumference of 12 feet 8 inches at 1 foot up, and 10 feet 3 inches at 5 feet up.

The "Yester Oaks," Haddingtonshire. No. 1 is in the grounds at the garden, and had a circumference in 1854 of 13 feet 10 inches at 3 feet up; in 1880, 14 feet 10 inches—an increase in twenty-six years of 12 inches. No. 2, on the left side of walk from Yester House to the garden, had a circumference in 1854 of 13 feet 6 inches at 3 feet up; in 1880, 15 feet 6 inches—increase in twenty-six years, 24 inches.

The "Capon Tree" stands a few yards off the road in the level haugh near to the low bank of Jed water, on the Ferniehirst estate of the Marquis of Lothian, in Roxburghshire. There are differences of opinion as to how the name "Capon" came to be applied to the tree, but the theory that seems to find most acceptance is, that it was the "meeting tree" where the tenants assembled to pay their rents in kind. Although considerably damaged by the snowstorm of December 1872, it still presents an appearance of imposing grandeur. It has three gigantic limbs remaining, and girths 26 feet 6 inches at 3 feet up, 24 feet 3 inches at 5 feet up, and covers an area of from 80 feet to 90 feet.

"Old Capon tree, old Capon tree,
Thou standest telling of the past.
Of Jedworth's forest wild, and free,
Thou art alone, forsaken, last."

The "King of the Wood" grows at the top of a ravine about a bow-shot distant from the last, on the opposite side of the road, and although not possessing the rugged strength of its rival, it has yet a noble appearance, and is said to be another remnant of the great forest of Jedwood, so that the "Capon Tree" is not, as the poet sings, "alone, forsaken, last." It girths 16 feet 6 inches at 5 feet up, and is 78 feet in height.

The "Hartrigge Oaks," near Jedburgh, Roxburghshire, the seat of Lord Stratheden and Campbell. Nos. 1 and 2 are by the side of the mansion-house park, girthing 13 feet 10 inches and 11 feet 9 inches respectively at 5 feet up. No. 3 is near the north-east corner of the garden, and girths over 15 feet at 5 feet up.

The "Dalwick Oaks" grow on the south bank of the Tweed at Dalwick, Peeblesshire. No. 1, on the west side of the mansion house, girths 14 feet 9 inches at 1 foot up, 10 feet 8 inches at 5 feet, a bole of 35 feet, and a total height of 80 feet. No. 2 is on the east side of the mansion, and girths 17 feet 6 inches at 1 foot up, 10 feet 9 inches at 5 feet, length of bole 35 feet, and a total height of 57 feet. No. 3 is near the bowling-green, and girths 14 feet 10 inches at 3 feet up, and is 80 feet in height.

An oak in the low ground of the Home Park of Stobo Castle, Peebleshire, girths 11 feet 8 inches at 1 foot up, 9 feet 4 inches at 5 feet up, with a bole of 35 feet.

The "Barjarg Oak," in Nithsdale, is a remarkably fine tree. It has a girth of 17 feet above the roots, 11 feet 11 inches at 16 feet up, 11 feet 9 inches at 32 feet up, and 6 feet 8 inches at 46 feet up.

The "Lochwood Oaks," in Annandale, Dumfriesshire, have a circumference of 20 feet and 18 feet 10 inches respectively at 5 feet up.

It now only remains to be said, that in compiling the foregoing record of the oaks in England and Scotland, it is to be noticed that none in the latter country are returned as hollow, or to have been pollarded. Now it is fair to suppose that the operation of pollarding accounts for the larger girth of some at least of the English trees, and also for their being hollow.

IV. *The Beech Forests of Hesse Nassau.* By George Cadell, Esq., 14 Canning Road, Addiscombe, Surrey.

Waste Land in Great Britain Available for Planting.

If I venture upon a subject which is not specially set as one of the essays for the year, it is because I am unwilling to believe that the words delivered in the address to the Society of last year will, like so many words upon the subject of forestry, fall fruitlessly on the ground. It is specially necessary to remember in connection with these words, that the area of land available for the planting of trees in Great Britain is not in the strict sense of the word hopelessly waste. It is land which, owing to various causes—foreign competition, facilities and cheapness of transport, or, as some contend, the fluctuations of currency, or to a combination of these causes—can no longer be profitably occupied by ordinary agricultural crops. No less than 1,437,000 acres of land, which in 1869 were devoted to the cultivation of wheat, have, we are told, ceased to be so occupied. They are, therefore, available for the cultivation of other crops, which, however unremunerative they may be as compared with wheat, may yet produce something, and when they are occupied by crops which do not exhaust, but, on the contrary, improve the bearing capacity of the soil, the argument, in case a different condition of matters arises, is very greatly strengthened. If no interest at all were obtained in the shape of yearly returns, the planting of such areas with trees would be amply justified by the enhanced value of the capital. The income derived from forests or woodland, in short, cannot be compared directly with the income derived from wheat or other annual produce. It is, I think, necessary to bear this very prominently in mind, otherwise the planting of waste lands, either in our own or other countries, is not very intelligible.

The State Forests of Hesse Nassau.

It was with a full recognition of this unobtrusive but valuable "improvement" that I went over the beech forests of Nassau the other day in company with the Öber Förster in charge of the division. And while I have really nothing new to tell, no one with a love of forestry could go over the excellently administered forests of Prussia without either learning new lessons, or having old ones practically and usefully enforced. For here we have, broadly speaking, no land "out of occupation." In the storm-swept plateaux, which produce nothing but tufty grass, we have what I suppose "statistics" would schedule as waste land. But even these have their fringe of weather-beaten spruce or other firs, whose flat tops afford a protection and shelter to their more favoured brethren. Nearly one-half—42 per cent., I believe, is the exact proportion—of this part of the empire is occupied with forest. And of this forest perhaps three-fourths are beech.

The beech, as we know, has the credit of dominating and subduing all other trees which come within its influence. Neither grass nor underwood is tolerated under its shade. And if, in order to satisfy the demands of the vine-growers for stakes to support their trailing and clinging crops, some oaks are grown and maintained, their presence in long-drawn lines appears only to emphasise the position, viz., that we are in a country of beechwoods. Not the far-spreading beech trees of our parks and meadows, but the tall plain columns crowned with a continuous canopy of leaves, through which the sun, with side-long gleam, strikes in those mingled lines of light and shade on which artists love to dwell, and in which all lovers of Nature delight.

Foresters will understand what sort of woods these were, which were estimated to contain between 500 and 600 cubic metres [1] of solid timber per hectare,[2] worth something over 10,000 marks; [3] while on every side were bundles of firewood, also of beech, containing 4 cubic metres, and worth from 30 to 40 marks each. The gross revenue derived is 40 marks or thereby per hectare, reduced by expenses of management, etc., to a nett revenue of 20 marks per hectare.

I am not going to follow the statistician into any application of these figures to the waste lands of Great Britain. The agricultural statistics will, I understand, make him a present of something like 28 millions of acres of waste and unoccupied land in our islands, and allowing for deductions, after the usual gracious way of estimators, he can yet obtain a very handsome revenue as well as capital, on paper.

I will rather pass to another item of practical experience in Nassau, which seemed to me to be rather high. The cost of plant-

[1] A metre is = 3.280 English feet.

[2] A hectare is = 2.471 English acres.

[3] A mark is = 11¾d. sterling.

ing an acre of wood appeared to average about two (£2) pounds sterling, as under,—three thousand plants were put in each acre, at an average contract price of 13s. 6d. per thousand. Of this fact also I make a present to the statistician, begging him to note my courtesy in giving him without circumlocution the comparative cost in plain figures. But so much depends upon the size of the area planted, its accessibility by waggon-roads or otherwise, that while the above figures have a charming simplicity, their application to British soil would, or might be, very misleading.

I have been talking hitherto of the Government forests of Hesse Nassau, grown, let it be further noted, on most favourable conditions of soil, a loamy clay mixed with sand ; and while these occupy by far the greater proportion of the land under wood, yet its administration and government into which I need not here enter, offer no lessons to the British official—for within the limits of our own Crown forests there are " rights " which fetter in no small degree the free action of their nominal rulers. I think it well therefore to pass on to a different matter, viz., the administration of communal and private forests in Hesse Nassau, for here we may possibly find lessons and borrow examples, which may be useful to us in Great Britain, where our forests, for the most part, are in the hands of private individuals.

Combined Efforts of State and People in Nassau to Plant Waste Lands.

It is very certain that if we are ever able to inaugurate a useful system of forestry in this country, it will be by reciprocal help—the help of the landed proprietors in placing their woods at the disposal of the Government for such time as may be agreed on ; the help of the State in affording facilities for planting and professional advice.

Exactly such a system obtains in this part of Prussia. Not only does the State help in the planting of any land that is or may become waste, but all the forests of the country belonging to municipalities or to private individuals are administered in accordance with the advice of the forest officer of the district. Nay more, they may not be administered otherwise. The State prevents the waste of their property by private individuals, as well as assists in its maintenance, and it does this in the interest of the public good.

Granted that the same pressing reasons for such action do not exist in Great Britain, it cannot be for the interest of the public good generally that so much land is lying useless, or only cultivated at a loss to its owner. And it cannot be fair to place the responsibility for such a waste of the soil on any one individual or set of individuals. We are told, of course, that the planting of trees does not pay, and the same arguments for non-action are repeated *usque ad nauseam*. Such excuses, for they are apologetically offered, would not commend themselves—even if there were no colonial requirements to consider—to an estate administered with an eye to the future as well as to the present, such as we see in the district of Hesse Nassau. If the Nassau State forests are regulated as to their felling and replanting, on what is known as the rotation system, the land generally is utilised in perpetuity somehow. It is not all capable of producing the world-renowned Johannisberger wine, nor can its uplands compete with its valleys in the production of corn, but where fruit and grain cannot be cultivated, there is room for the useful rye and the needful forest. Each part has its capacity noted on the field map, each part contributes its share to the general good.

I have endeavoured, in the accompanying Map of the topography of the district of the Taunus, one of the principal ranges of Hesse Nassau, and containing some of her most important forests, to give effect to this partition of the capacity of the soil; and I trust that my feeble efforts in this direction may be leniently dealt with, and measured rather for what they aim at than what they really are, for in carefully sketched field maps I see the beginning of practical forestry, as well as of practical agriculture, geology, or anything else. In forestry, as well as in other science, we must have a clear idea of where we are driving to, before we enter on any decisive course of action.

Duties of the Öber Förster to Individuals.

The details of such cultivation in Nassau are settled by what I may call the county and municipal councils of the country, of which the Öber Förster is *ex-officio* a prominent and important member. He can, in effect, place his veto upon any action, such as prodigal cutting and the devotion of an undue proportion of the area of the country to the cultivation of agricultural produce, absolutely. He must be jealous, too, of what is known as the "possibility"—that is, the fair yield of the forests—being endangered or exceeded. But he is, at the same time, no arbitrary

State official, forcing an unintelligible course of action down the throats of the council. He is there as their friendly adviser, working for and with the people, considering their interests as well as those of the State, which are in reality the same.

In no less friendly, if responsible, relationship does he stand to the private proprietor. He, too, is not at liberty to cut and fell his woods as he pleases. *Nummi non possessor sed custos solum* is the motto which may be written on his private property, for, so far as his forests are concerned, he is the steward, not the irresponsible possessor of his landed revenues. Here I may take occasion to observe that the deer and other game which are sheltered in the forests are not necessarily the property of the lord of the soil. They are exposed to auction, and the proprietor may or may not be the successful bidder. He has, at any rate, to pay for his shooting, starting on all-fours with any outsider.

Application of these Principles to Great Britain.

I may be told, on the one hand, that such a state of matters as interference with the sacred rights of a landlord would not be tolerated in Great Britain; and I may be told, on the other hand, that there is no money available in the State treasury to assist proprietors in the planting of waste land. I do not think there is much in either objection. Many of our proprietors, in Scotland at any rate, have been accustomed to hold their lands, as it were, in trust for their successors. They have willingly embarked on "improvements" of which they could not hope to reap the benefits. They have not only expended capital on such improvements, but they have submitted to a loss of any interest accruing on such capital. They have, in a word, although they have not always got the credit for it, acted as stewards for their heirs. The other objection—"no funds available," is the familiar cry whenever anything not palatable to the powers that be is proposed. It is doubtless perfectly right and proper that the expenditure of the national funds should be carefully scrutinised, and their disbursement jealously guarded; still, they are there for the good of the nation, and should be spent in accordance with their expressed wishes. I will not here allude more particularly to the Report of the Parliamentary Committee on Forestry. This, if it erred anywhere, erred on the side of moderation—and it has suffered accordingly. I have no data by me which show the actual cost of State aid to planting by private proprietors in Nassau. But this cannot be much, and need not be in reality anything. Nurseries, or "Först Gartens," are scattered all over the country, and from these, surplus seedlings can be given to proprietors who will promise to plant them, with positive advantage to the nurseries themselves. If money is asked for them, although I will not allude to the shabbiness of the demand, they can be given at cost price, which, if conscience enters into the calculation, will be infinitesimal. It is more the moral support and recognition by the State that encourages private individuals to plant than the actual money assistance.

I am getting far away, it may be thought, from my beech forests, and yet not only their dense masses, but the "shimmer" of their countless leaves in the mixed woods of the country, are with me as I write. I see, too, the leaf-covered tunnels of beeches, which form the favourite alleys of the private gardens. And I see, in what Selby, I think, tells us was its original habitat, the red foliage of the copper beech contrasting with and toning down the mass of green. If I have unwarrantably made use of them, in the hope of attracting further attention to the policy of which they are the living tokens—a policy of pulling together by Government and people, under circumstances of difficulty, too intricate for their separate and divided efforts—I shall ask the pardon of my readers. I have not pulled the bow too strongly. I have carefully refrained from even mentioning those other measures of "relief" to proprietors of waste lands, which may commend themselves to the attention of our newly formed County Councils. I have not set forth an ideal, but an existing, and, I may add, a successful state of matters; and in doing so I have purposely avoided all those details of forest administration which have been once and again explained by far abler pens than mine; and, except for the purpose of giving some idea of the size of these grand beech forests, I have kept clear of statistics and figures, which may be elsewhere ascertained. Those who visit our Continental neighbours will do well to examine for themselves the *raison d'être* of the forests of the country, which will everywhere afford them at once a playground and a study.

V. *The Natural Regeneration of Woods.* By WILLIAM SOMERVILLE of Cormiston, D.Œc., B.Sc., F.R.S.E., Lecturer on Forestry, Edinburgh University.

If the rearing of a young wood, by means of self-sown seed, upon the same ground as that previously occupied by an older generation of trees, is to be successfully accomplished, an amount of skill is demanded of the forester which can only be derived from careful training, long practice, and an intimate knowledge of the requirements of the trees placed under his charge. The difficulties are increased by the fact that generally a long series of years must elapse from the initial stages of the process till the regeneration is accomplished, so that, as frequently happens, the work is not directed in all its stages by the same hand, and unless each successive step be made at the right time and in the right way, total or at best partial failure must be the result of even the most auspicious beginning.

In countries where State forests bulk largely in the wooded area, and where consequently ample provision is made for the training of foresters in the science and practice of their profession, no difficulty is experienced in bringing to a successful issue any sylvicultural system which may be inaugurated. As the men who have guided the work are one by one removed, their places are taken by those who have received their training in the same rigorous school as that in which they themselves were educated, and who are therefore fully qualified to carry forward the work, long since begun, on the lines which experience has shown will ultimately lead to the greatest success.

The impediments which obstruct the path to the successful formation of woods by means of self-sown seed are so great, and the advantages and convenience of stocking the ground by artificial means, are in most cases so apparent, that in all parts of the world, whenever forests have been brought under scientific sylvicultural treatment, the cases where natural systems of renewal are held to offer greater advantages than artificial systems gradually diminish, till finally they form but a small proportion of the whole. Still it is highly improbable that artificial planting and sowing will ever in all places and under all circumstances completely displace natural sowing, so that it is not too late to consider the cases and conditions under which the latter system may be most advantageously adopted, and to look as shortly as may be at the best means of attaining the end in view.

Speaking generally, it may be said that the fulfilment of the following conditions would chiefly influence the adoption of natural regeneration in preference to artificial restocking.

1. Where the state of the surface of the ground is such as to offer the conditions requisite for a good seed-bed without the aid of any artificial preparation. This consideration gains additional weight when the financial condition of the estate is such as to make the restriction of all outlay to the very minimum almost a necessity, as well as in cases where the quality or value of the timber is so low that, in order to get even a small balance on the right side, the expenses must be kept down to the lowest point. In outlying districts, also, where the cost of conveyance reduces the profits within very narrow limits, it frequently happens that the only way to secure any return at all from the woodlands is to avoid all outlay in their formation.

The cases where no artificial aid is required to bring the surface of the ground into a suitable condition for the reception and germination of the seed are, comparatively speaking, few, and are for the most part only to be looked for in close well-managed woods of shade-bearing trees (beech, silver fir, etc.), and then only if the trees are not too old, and in the absence of destructive gales. In many other cases, no doubt, a patchy incomplete stocking may be looked for, but that perfect regularity in the distribution of the young plants, which has so much to do with the future success of the wood (and a considerable departure from which must bring, at least, partial failure), is attained without artificial preparation of the ground in very few cases indeed. If weeds must be removed, and the surface broken by means of hand implements before a good seed-bed is secured, the expense incurred is frequently much greater than the cost of stocking by means of planting.

2. On steep, bare, rocky declivities, and in high exposed situations, the system of clear-felling one crop of timber, and then restocking the denuded area by artificial means, admits of serious loss, occasioned by the washing action of rains and melted snow during the time that the surface is destitute of trees, or before the young generation has developed sufficiently to shade the ground. Especially undesirable is it to clear-fell a wood

where the surface is thickly strewn with large boulders, or where the bare rock projects in large masses, because so long as a close wood is preserved the leaves accumulate to form valuable plant-food, and, in coniferous woods, moss grows in great luxuriance, so that a good seed-bed is provided even on what would otherwise be a bare rock-surface, and the young seedlings ultimately push their roots into cracks or crevices, or ramify over the rocky surface till they get at better soil, and so large well-grown trees are not unfrequently to be seen in situations which they could never have occupied had they not been self-sown. Let such an area be cleared of its trees even for a few years, and the moss and humus will, under the combined influence of sun, wind, and water, entirely disappear from the rocks and boulders, for shade and a humid atmosphere, such as are to be found in a dense wood, are absolutely necessary for the formation of forest humus, and the production of a rank growth of mosses. The fact must not be overlooked that rocks covered by decaying vegetable matter or mosses weather much more rapidly than where unprovided with a covering, for the carbonic acid gas resulting from decomposition of the humus, and the solutions exuded from the roots of plants, act far more powerfully than rain or the atmosphere in corroding rocks and rendering their ingredients soluble.

When a locality, in the enjoyment of unrestricted sunlight, is apt to produce a very rank growth of ground vegetation, such as ferns, heather, blackberries, large grasses, etc., it is often advantageous to restock by self-sowing before felling all the old trees, for in this way the weeds are kept in check till the young trees have had time to surmount them. This is often the case on moist, rich, loamy soil, especially if calcareous. Here such a rank growth of herbaceous vegetation would spring up after clear-felling, that small slowing-growing trees would be apt to be smothered, or one would be compelled to give them light and air by mowing the weeds, unless recourse was had to the expensive operation of restocking with extra large trees.

3. A third case where natural regeneration may be advantageously resorted to occurs where we have to deal with species of trees which are very liable to be injured in youth by too powerful atmospheric agencies. This is the case more especially with the beech and silver fir. When young both these trees are very sensitive to frost, heat, and drying winds, from which they can

be best protected by regenerating under overhead shade. This protection can be procured as well when the young generation is formed by artificial sowing or planting under a shelter wood, as when from self-sown seed, but if the trees which give the shelter can also yield the seed, it is a manifest advantage to utilise them in this way as well. To the two species just named may be added the spruce, which, on account of its shallow roots, is apt to perish on dry land during the first few years of its existence, unless the surface soil be kept sufficiently moist, and nothing conduces more to this end than the shading of the ground by overhead foliage, and the exclusion of drying winds. As we shall see afterwards, the natural regeneration of spruce woods is attended with great difficulty in windy regions, but where a locality is sheltered from violent gales the system may frequently be advantageously adopted.

4. Where young trees are liable to be destroyed by insects, it has been found advantageous to rear them for some years under the shade of an older generation, for insects prove much less destructive under shade than on a cleared area. Here, again, the shading trees may also be the mother-trees, if no serious obstacles interpose to their being used as such; and the ravages of the cockchafer grub and the pine weevil may often in this way be successfully combated.

Where any return can be got from the roots and stools, the practice of felling conifers by stubbing their roots is strongly to be recommended, as it is very effective in keeping down the increase of all sorts of destructive insects, and, at the same time, the ground is brought into a suitable state for the reception of the seed.

5. Trees which grow well under the shade of others are much the most suitable for natural regeneration, and now the system is being more and more applied in their case alone. Such trees are known as shade-bearers, and include the silver fir, beech, spruce, lime, and one or two others of minor importance, notably the yew, which develops almost as rapidly under considerable shade as in an open situation.

There are two distinct cases in which an area may be supplied with self-sown seed, and where consequently a system of natural reproduction may be put in force. The one is where the seed is furnished by trees (the shelter-wood) occupying the area to be restocked, and the other where the mother-trees stand at a greater or less distance from it. In the former case, the general conditions of the situation and the growth of the seedlings are influenced by the overhead shading; in the latter there is no vertical shade or shelter, though there is usually lateral protection. The former of these two cases in its various modifications being the more important, may be taken first.

The regeneration of a forest on a shelter-wood system may be accomplished in various ways, the most common being that where the whole is taken in hand at one time, that is to say, the several processes or stages in the operation of natural regeneration proceed simultaneously throughout the whole wood.

When it has been resolved to renew a wood by natural seeding, all efforts must be directed towards providing conditions which will be likely to bring about a successful result. It comparatively seldom happens that the surface of the ground is naturally in a proper state to receive the seed, and that the number and distribution of the trees over the area are such as to secure the proper conditions as regards light for the health and development of the young seedlings. It therefore becomes necessary, a few years before the actual shedding of the seed is to be expected, to undertake various preliminary operations in order to avert as much as possible the chances of failure. If the closeness of the wood is such that no weeds, but only dead leaves and twigs, cover the surface of the ground, this preparatory stage offers but few obstacles. It is then only necessary to make several very moderate fellings in order to hasten the decomposition of the raw humus, and to bring about a perfectly regular distribution of the old trees, so that every part of the ground may receive the necessary supply of seed, and at the same time be equally shaded. At first attention should chiefly be directed towards removing the smaller class of trees, namely, those that are overgrown, diseased, or poorly developed, and therefore not likely to bear much seed, as well as those species which it is not desirable to have represented in the next generation. If we are dealing with a mixed wood, the fellings should also be directed towards proportioning the trees as they are intended to be represented in the young wood, due regard being taken of the fact that some species produce far more seed than others, and that some seeds, especially those provided with wings, possess special facilities for distribution.

The advance fellings may take only one or two years to accomplish, or as many as ten or fifteen if the wood is situated in a region subject to heavy gales, or if the trees are of a shallow-rooted species, for in these cases the process of thinning must be very slowly performed, in order that the trees which are left may develop new roots, and so gain stability sufficient to enable them to withstand the action of wind.

In the early part of this preliminary stage, supposing it to embrace several years, the felling must not be so heavy as to cause interruption to any considerable extent to the leafy canopy, for were such brought about, sufficient light would reach the ground to enable strong weeds to gain a footing which would make the surface very unsuitable for the reception of the seed, and, besides, owing to direct insolation and the entrance of drying winds, great loss of fertility would result.

If the wood is rather thin, a proper advance felling may be altogether dispensed with. There is, however, one case in particular where very considerable felling is necessary, namely, in very dense woods of broad-leaved trees, especially beech. In such a case the ground is covered by a thick layer of humus, which is only partially decomposed. Such a covering would not interfere with the germination of the seed, but would be apt to bring about the death of a large number of the seedlings during the first few weeks of their existence. This is due to the fact that a layer of raw humus is subject to great variations in the degree of moisture, so that, if the rootlets of the young plants ramify in this material alone, they are not so able to withstand any considerable spell of dry weather as they would be were they fixed in the mineral soil lying underneath. So long as the layer of leaves and twigs is shaded from the sun, sheltered from the wind, and protected from the rain by a dense mass of umbrage, decomposition goes on but slowly, especially on cold stiff soils; but the process may be much accelerated by the removal of a considerable number of trees, and the consequent admission of light, air, and rain.

If the desired result is not attained by thinning alone, recourse must be had to the removal, by means of rakes, of part of the surface covering where densest, or the mineral soil may be stirred up and mixed with the raw humus by the aid of mattocks or heavy hoes. The former of these operations involves a cost of about 10s. per acre, the latter costing about twice as much, and both may generally in great part be avoided by bringing the wood into such a state that the natural processes of weathering can be utilised. If artificial aid must be adopted, it should not be put into force till there is an immediate prospect of seed being borne, for if some years elapse between the preparation of the soil and the seeding, the quality of the seed-bed will suffer severely, and the labour expended upon it may be for the most part lost.

Not only do the advance-fellings, if properly performed, prepare the seed-bed, and adapt the trees to offer greater resistance to storms, but they also induce the mother-trees to produce a large crop of seeds. This is the natural result of admitting light to the lower branches of the crowns, and is most apparent in cold districts, such as high regions, and north or east slopes.

In many woods one finds scattered here and there in small groups, or as single specimens, young trees which have sprung from naturally sown seed. These usually occupy the somewhat opener parts of the wood, which are accessible to direct sunlight, but whether they should be retained and fostered or be cleared away, depends on such circumstances as species and quality. If they belong to a kind of tree which it is considered desirable to have represented in the new wood, it is well to retain them, and to encourage their development by cutting out the old trees in their vicinity which are interfering with their growth, provided they have not grown so long in restricted light as to be incapable of ultimate normal development. Most in this respect depends upon species. Silver firs, for instance, have wonderful recuperative power, and may exist for more than fifty years in dense shade, and still retain their vital powers practically unimpaired. During this time they will have made but slow growth—the wood rings, in fact, will often be found to be of hair-like fineness—but when gradually placed in the possession of a greater amount of light, the foliage increases in quantity and becomes darker in colour, the wood-rings become broader, the leading shoot lengthens, and in a few years what before seemed a stunted bush acquires all the characters of a vigorously growing tree.

In a close, or moderately close, wood any advance growth which may be met with must, from the very nature of things, consist of some shade-bearing species of tree, for no young light-demanding tree could exist for any length of time under such conditions. Where, however, the wood is open, or where blanks have been occasioned by any cause, advance growth of such light-demanding trees as the Scots pine, birch, etc., may be met with. It is but seldom, however, that such advance growth can be utilised, for, if light-demanding trees have become stunted when young, they never recover to such an extent as to form desirable objects for future encourgement. They should, therefore, be cut out in the preliminary stage, as should also all growth of the nature of brush or underwood, *e.g.*, sloes, aspen, bird-cherry, willows, etc. These frequently prove a serious annoyance in natural regeneration, because, when cut over, they reproduce themselves by means of stool or root shoots, which, growing with great vigour, are apt to choke out the slower growing seedlings.

When as much thinning has been done as is considered safe, attention must be directed towards discovering the first signs of an approaching seed year. In the case of the Scots pine, and the genus *Pinus* generally, where two years elapse between the time of flowering and the ripening of the seed, one always receives sufficient intimation that the production of a full crop of seed is near at hand. In the case of most of the other important trees, however, no such long intimation is given, for they ripen their seeds in the same year as that in which they produce the flowers. However, if one is watchful, a year's warning at least can usually be obtained, for, on account of their larger size, and in other ways, the flower-buds can be distinguished from ordinary leaf-buds in autumn, or, at any rate, in the course of the winter and spring. In the case of some trees, large quantities of seed are produced every two to three years, whereas many trees do not bear oftener than once in eight to ten years. Where we have to deal with a species of the latter class, *e.g.*, the beech, we must be specially careful not to let the opportunity slip of availing ourselves of a seed year; but, at the same time, the work of preparation must not be completed too long in advance, for unfavourable weather may intervene during the time of flowering, or in the succeeding summer before the fruit has ripened, which may cause the yield of seed to be very disappointing. Where the wood is of moderate dimensions it is best to wait till autumn before completing the advance fellings and final preparation of the surface, but where large areas have to be regenerated it is scarcely possible to delay beyond midsummer. In either case, however, if a large production of seed be regarded as tolerably certain, the wood must be brought into that state in which it will be most favourable for the reception and germination of the seed, and for the development and protection of the young plants. At this time the heaviest trees must be felled and removed, partly to provide the future young trees with light as well as to facilitate the entrance of rain and formation of dew, and partly because the removal of specially heavy trees after the young seedlings occupy the ground would be sure to damage them excessively. At the same time attention should be given to felling all trees which are provided with low-reaching branches, as these, owing to the excessive shade which they produce, are apt to act prejudicially on the young generation. If, however, such trees must be retained, in order to furnish the necessary seed, or for purposes of protection, then all their branches ought to be removed for 20 feet from the ground.

The species of tree, kind of soil, climate, etc., must regulate the amount of shading which should be retained at this time; or, what is the same thing, these considerations should decide the extent of the seed felling. In the case of shade-bearing trees, it is usually sufficient to bring the wood into such a state that the edges of the crowns of the trees are separated 3 to 9 feet from each other, which implies the removal during the advance and seed fellings of from a quarter to three quarters of the original number of trees. Light-demanding trees require at least twice this amount of thinning unless a subsequent felling can be made very soon after the seed year, in which case it is better not to fell too heavily at first for fear the seeding should not be successful or complete, when it may be necessary to supplement by utilising a second seed year.

As a general rule, one should not make the wood too thin where the land is of the character which predisposes it to produce a strong growth of weeds, for the only way of keeping them in check is to retain a considerable amount of shade. Here, again, species must be taken into account, for the rate of development in youth varies greatly, some—for instance, the silver fir—growing very slowly when young, and consequently being liable to be choked by rank vegetation, while others, such as the larch, grow so rapidly as soon to be out of all danger from this cause.

In frosty localities, or in the case of tender trees, more shading should be retained than under opposite conditions; and the same is true where insects are numerous, or where the soil is very dry and apt to suffer from excessive drought.

Should artificial assistance be necessary, the stage of the seed felling is the most suitable time to complete the preparation of the seed-bed. If the advance fellings have been too heavy, or if severe gales have occurred, a considerable amount of ground vegetation may have found a footing. This must be got rid of, at least in part; but if not very plentiful, the disturbance of the surface occasioned by felling and dragging the trees is usually sufficient preparation. If the trees have been felled with their stools attached, and if the holes thus made in the ground have been carefully levelled, an excellent seed-bed is produced at such places. A practice which cannot be too highly recommended, both on account of its efficacy and cheapness, is that of allowing swine to run in the wood during the summer, autumn, and winter of a seed year. These creatures grub up the ground, spread the heaps of dead leaves, destroy enormous numbers of grubs and mice, and in various ways prove extremely useful. Even in beech or oak woods, where one would expect them to destroy considerable quantities of fruit, they are found to do far more good than harm.

In the case of woods consisting of light-demanding trees, *e.g.*, Scots pines, larch, etc., where it has not been necessary to undertake any advance fellings—that is to say, where the seed felling has been the first felling of all, the surface of the ground is generally provided with a thick covering of moss or grass, which must be partly removed before successful germination can be looked for. If horse implements, such as ploughs, harrows, or grubbers, can be worked it is sufficient to scarify the ground in narrow lines about 3 feet apart; but if, as is oftener the case, the nature of the ground does not admit of horse labour, there is no help for it but to remove the mossy or grassy covering in stripes or patches by hand labour, with the aid of rakes, hoes, spades, or mattocks. Where one has to deal merely with moss, raking is quite sufficient, the preparation of an acre requiring four or five days. If heavy hoes or mattocks must be employed (and these must be resorted to when an actual sward of grass is present), the expense mounts up rapidly, as it may take ten to twenty days to prepare an acre, the time depending on the amount of preparation deemed necessary, as well as upon the nature of the situation. Where ploughs can be used, and if single furrows be turned at distances of 3 feet, at least two acres may be overtaken in a day.

In the case of the lighter seeds, those of the pines, firs, larch, birch, etc., no covering is necessary, and consequently, if deemed advisable, the preparation of the ground and the felling and dragging of the timber and branches may be completed before the seed is shed; but where one is dealing with large seeds, such as those of the oak, beech, or chestnut, some covering must be provided. This may be obtained by raking the surface with heavy rakes immediately after the seed has fallen, which of course adds considerably to the expenses of regeneration; but in practice it is found better, if possible, to delay the preparation of the surface by raking, ploughing, or hoeing, till just after the trees have shed their seed, when the preparation of the seed-bed and the covering of the seed may be performed by one and the same operation. Where no artificial preparation is necessary, but where it is desirable to cover the seeds, it is well to delay making the seed-felling till late in winter, when the disturbance to which the surface of the ground is subjected, by the felling and dragging of the timber and branches, usually suffices to bury the seeds to the required depth.

If the ground has been sufficiently supplied with seed which has germinated satisfactorily, the future use of the old generation of trees is chiefly confined to protecting the young plants against extremes of temperature. If, however, owing to some cause or other, the stocking of the ground is defective, the old trees must be still further utilised for the production of seed. For this purpose a sufficient number must be retained till a second seed year has come round, their distribution over the area being regulated by the appearance of the young wood.

If the blanks or patches which are insufficiently stocked be of inconsiderable size, they may often be filled up by transplanting young trees from parts of the wood where the stocking is so dense that they can be easily spared. These young trees should be lifted with balls of earth adhering to their roots, and as they need not be carried far, the operation is not an expensive one, and the results are excellent. If this practice be adopted—and leaving advance growth out of the question—the young wood is absolutely even-aged, for all the trees have been produced from seed shed during one year; whereas if two or more seed years have been utilised, differences of as much as ten to fifteen years in the age of the young trees are unavoidable. In later life such slight differences become unrecognisable, so that, to all intents and purposes, such a wood may be regarded as even-aged, though, strictly speaking, it is really uneven-aged.

In those parts where the regeneration is quite satisfactory, and where consequently no more seed or plants are required, the length of time during which the old trees should be retained is regulated by various considerations. In the case of shade-bearing trees, which are liable to suffer from frost, the old trees should not be removed too soon, for though their shade will somewhat retard growth in the younger trees, it will not cripple them, and will prove very beneficial in the way of protection. Where, however, we are dealing with light-demanding trees, the subsequent felling, or light-felling, as it is sometimes called, must on no account be long delayed, otherwise the effect on the young generation will prove very prejudicial. In the latter case, the subsequent felling should be made in the first, or at most in the second, autumn after the seed has germinated, when the whole of the trees may be removed in either one or two fellings; or twenty to thirty per acre may be retained as standards to grow through the whole of the second rotation, and so form extra heavy timber. In the case of the beech, spruce, silver fir, etc., the subsequent felling should be subdivided into several fellings, the last of which—*i.e.*, the final felling—need not be undertaken till ten or more years after the seed felling, though during that time a considerable number of trees should be removed every year or so in order to satisfy the increasing demands for light on the part of the young trees.

Speaking generally, the subsequent felling should be most quickly performed on poor dry land, because the shade trees partially prevent the entrance of rain, and yet are so scarce as not to be able to hinder evaporation to any appreciable extent. On north or east slopes, also, or at high elevations, where the growing season is short, the retention of many old trees for a considerable period would retard growth in the young trees to an undesirable extent.

On the other hand, the subsequent fellings should not be hurried where late frosts are almost annual in their recurrence, as well as on all strong soils, especially those resulting from the weathering of limestone, basalt, or porphyritic rocks, because there strong weeds are to be apprehended; and besides, on such rich soils trees can bear an amount of shading with impunity which would soon kill them on poorer soils.

It is needless to say that very great care and skill are required in felling the old trees after the young trees occupy the ground, so as to prevent the latter being excessively damaged. Unless snow cover the ground, all operations should be suspended during hard frost, as at that time the young stems are very brittle, and specially liable to be broken. Where the trees are provided with large branches, they must be pruned before being felled, an operation entailing a great deal of labour, but one which it is impossible to avoid.

The system which has been sketched, namely, the simultaneous natural regeneration of whole woods under shade trees, has the advantage that the operation in all its phases is confined to a limited period, and is concentrated into a compact area, so that the work can be easily controlled and directed. If all goes well, then a large measure of success may be looked for, but if the operations have not been skilfully conducted, or if severe gales have overturned many of the mother-trees before seeding has been accomplished, and the young plants have become securely established, or if it should turn out after seed-felling that the trees are so old as to be incapable of bearing a sufficient quantity of good seed, then, indeed, the consequences may be most disastrous. In the event of failure from any cause, the surface of the ground is long deprived of the shade and shelter afforded by the young crop of trees, and if the situation is naturally a poor one, that is to say, if it has the store of forest humus chiefly to thank for its productive power, the fertility which has been gradually accumulated during the previous rotation is soon dissipated to such an extent that the restocking of the ground, either artificially or naturally, becomes a most difficult matter. If the soil is naturally rich, then the same danger sinks in significance, though only in situations of the very highest quality can it be said to disappear altogether.

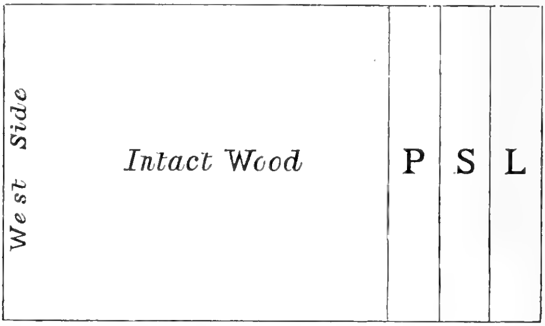
It is always well to guard against great calamities by not taking very large areas in hand at one time. Large woods should be divided into compartments of moderate size, which may be regarded as separate woods, and be regenerated at different times.

The system works best where the area is pretty flat and the soil of the same character throughout, because in that case the closeness of the wood and the development of the trees are uniform over the whole area, so that there exists no necessity to hurry the operations in one part and delay them in another.

Having looked somewhat carefully at the foregoing system, the others may be dealt with much more shortly. The advance, seed, and light fellings are more or less common to all systems, and therefore what has been already said in connection with them need not be repeated.

The system which we have already considered undergoes an important modification when a wood, instead of being simultaneously regenerated over the whole area, is divided into a number of bands or stripes, each representing some particular stage of regeneration. This gives rise to the system known as the shelter-wood band system, under which one commences the process of regeneration at one side of the wood, and proceeds systematically towards the other. It is of great importance to begin at the side of the wood farthest away from the quarter from which the severest gales blow —that is to say, in this country one would begin on the east or north-east side, and work towards the west or south-west. By so doing a compact mass of wood is interposed between the gales and the part of the wood undergoing regeneration, so that the trees which are semi-isolated in the advance, seed, or subsequent stages are well protected, and not likely to suffer much from gales, and the partially exposed surface of the ground is sheltered from drying winds.

In the simplest form three bands are in hand at the same time. One of these bands (L) is in the light-felling stage, another (S) adjoining is in the seed-felling stage, while a third (P) is in the preparatory stage. All the wood lying to the westward of band P is still untouched, and consequently, so far, is not embraced by the process of regeneration.

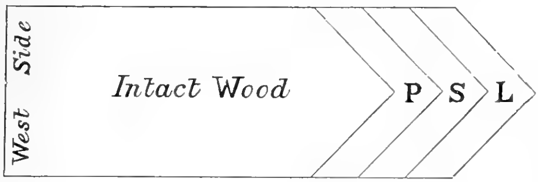


The simple case which we have just glanced at is often applicable to woods consisting of light-demanding trees where little advance felling is necessary; in fact, it often happens, under such circumstances, that band P can be dispensed with altogether, and so we have only to deal with bands S and L. On the other hand, where much advance felling and preparation are necessary, as is generally the case where the wood is very dense, or where we have to deal with trees provided with very shallow roots, as well as in windy regions, it is not sufficient to have only one band in the preparatory stage at any given time, but several must be simultaneously undergoing moderate felling—that is to say, there must be several P bands.

Another modification occurs where groups of serviceable advance growth fall to be dealt with. These will be met with irregularly distributed throughout the untouched wood, and light must be given to foster their development by moderate fellings being made in their vicinity. As the regular regeneration bands move forward, the advance growth groups are embraced by them, so that it may happen that final felling is being done in these groups at a time when the band in which they are then situated is only in the preparatory or seed stage. Although such a case introduces us to a compound system (composed of the union of the shelter-wood band system and the one which we shall look at presently, namely —the shelter-wood group system), it need present no extraordinary difficulties, and, if the groups of advance growth are of good quality, it would be most irrational to neglect them.

As regards the breadth and length of the bands, no hard and fast rule can be laid down. It is usual to make the breadth correspond to the height of the trees (60 to 100 feet), while the length is regulated by the dimensions of the wood measured from north to south.

If the length of the wood from east to west is very great, and if, at the same time, the length of the bands (*i.e.*, the breadth of the wood) is short, it may be advisable to commence regenerating at two places, one on the extreme east and the other in the middle; or the process may be hastened somewhat by making the bands elbow shaped instead of straight, but this must only be done in well-sheltered districts. Where elbow-shaped bands are adopted,



or where it is impossible, owing to the configuration of the ground, to fell directly towards the wind, it is often advantageous to leave a part of the wood on the west side intact, so as to act as a shelter-belt and break the force of the gales.

This system offers several advantages as compared with the foregoing one. Here the danger of total failure over a large area is avoided, the risk of the seed and shelter trees being overturned is not so great, and as the parts of the wood which are light thinned are, for the most part, sheltered from sun and wind by a close wood lying to the south-west or west, soil fertility is well preserved. All trees may be treated under this system, but it is specially suited to the wants of the Norway spruce.

The objection that the regeneration of a wood in this way is a process slow of accomplishment has not much force, and is altogether lost sight of after a wood has once been gone over, for then we have to deal with a series of age classes systematically arranged, the oldest of which is taken in hand first, and at a time when those which are younger are not ready for regeneration.

When regeneration is accomplished in neither of the two ways already considered, but by taking certain irregularly distributed groups in hand as occasion demands, a third system presents itself, which is known as the shelter-wood group system. Under this system all groups of advance growth are specially attended to, and their occurrence regulates, to a considerable extent, the points where felling should be done. Groups of young seedlings which have found a footing in the open parts of the wood, even though embracing an area of only a few square feet, must not be overlooked, so long as they are not stunted in growth, and, owing to this cause, incapable of future development. Advance or seed fellings, properly so called, cannot be spoken of in connection with these groups, for they have sprung into existence without any artificial aid being given. They must, however, be fostered by light fellings being made round about them, and these fellings become advance fellings for other groups which will subsequently spring up in their immediate neighbourhood. By this means each group is constantly being enlarged, like a crystal or a snowball, by the deposition of material on the outside, until ultimately, by group joining on to group, the regeneration of the whole wood is accomplished.

Although groups of advance growth form special objects of care under this system, still there are certain circumstances when points of the wood must be attacked for other reasons than the fostering of young trees already established. This happens where patches of old trees occur which are in an unhealthy state, owing to such causes as insect or fungoid attack; or where, in a mixed wood, certain species are ready for felling sooner than others; or where extra old and heavy trees, the survivors of a former generation, have reached maturity, as well as where groups of trees have ceased to grow owing to the effects of situation, etc.

In removing old trees, in order to provide sufficient light for the young groups, one must look not only to the vertical shade, but also to that which is due to the laterally situated trees. Where a group is surrounded on all sides by a dense wood of tall trees, most light will be let in with the least amount of felling by attacking the old trees on the south and west sides rather than by felling on the north and east sides.

Regeneration of a wood under this system usually takes from thirty to fifty years to accomplish, and the result is an uneven-aged wood, with the various age classes distributed throughout in groups of all conceivable shapes and sizes.

Provided the management be firstclass, this system has much to commend it. It recognises and provides for temporal and local variations, and admits of parts of a wood being taken in hand at a time when they most require regeneration, and when the operation would be most likely to succeed. It preserves soil fertility from loss better than the two systems already considered, for the surface of the ground occupied by the groups is protected from the sun by the overhead foliage, and from the entrance of drying winds by the intact wood which surrounds them, or by the young groups which have previously been established. It is most in vogue in mixed woods of shade-bearing trees, especially where, owing to greater exposure of certain parts, soil fertility is being reduced, or where, owing to any cause, closeness has been partially interrupted and advance growth groups have established themselves.

A modification of the last system is made use of in some countries, and differs from the one we have just noticed, in so far as it does not deal with groups of young trees so much as with isolated examples. These are tended in exactly the same way as the groups in the former case, but here the regeneration is extended over the whole length of the rotation, so that all seed years are utilised, and one finds represented in the wood trees of all ages, from the one-year-old seedling up to those which are perfectly mature.

This system ensures a constant covering for the ground, and is therefore most adapted for districts where violent gales are very frequent, as well as for steep declivities, where the action of snow or water would be apt to rush away soil or rocks were the wood clear-felled even in part.

It is the system which most effectually preserves soil-fertility, for as the ground is constantly shaded, no opportunity for loss is ever presented. It can only be practised in the case of the most decidedly shade-bearing trees, such as the silver fir and beech, though in woodlands of small extent, where constant care can be given, it is not inapplicable to the regeneration of spruce woods.

The four systems which have been described have this point in common, namely, that the seed is furnished by trees actually occupying the ground to be restocked.

We shall now look for a little at the other division of the subject, namely, natural regeneration of a clear-felled area by means of seed furnished by trees situated to the side of that area. Here the seed is borne from the mother-trees to the clear-felled ground by the wind, or directed by the slanting course imparted to its fall by the wing with which many seeds are provided. It is therefore evident that the system is only applicable to cases where one has to deal with light or winged seeds, except where, as on the side of a declivity, the cleared area lies at a lower elevation than the mother-trees. In such a case even large and heavy seeds, such as beech nuts, acorns, and chestnuts, may, by rolling down hill, be disseminated for a considerable distance from the trees which produced them. As a matter of fact, however, this system is hardly ever practised, except in the case of woods consisting of pines, larch, firs, spruce, elms, birch, willows, and acers; but in the case of these trees, if properly conducted, it yields satisfactory results.

The first consideration must here be given to the direction from which the prevailing winds blow, so that the area to be sown shall lie on the lee-side of the mother-trees. A band of trees is cleared only during a seed year, and the felling, dragging, and carting of the timber over the bare ground is generally all the preparation which the surface requires. One band must be carefully regenerated before any more felling is done, otherwise an imperfectly stocked wood will be sure to result.

When it has become evident that little more is to be hoped for from the self-sown seed, blanks are filled up by transplanting young trees with ball-roots from the denser parts.

The breadth of the band varies with the height of the trees and with the species. In the case of the acers, ash, and silver fir, the breadth should not exceed about twice the height of the trees, with the spruce and Scots pine it may be as much as four times the height, while in the case of the larch, elm, willows, poplars, and birch it may be increased to eight times.

Under this system the young trees are, from the first, placed in the possession of ample light, even though a dense wood lies to the south or west, and consequently it is specially applicable in the regeneration of woods composed of light-demanding trees. It may also be usefully put into practice on steep slopes, the bands when run from the base towards the top of the hill forming a convenient passage for the transport of the timber.

Blanks in woods, if of only moderate extent, may frequently be restocked by adopting this system, provided the ground is in a suitable state for the reception of the seed, which is blown from the surrounding trees to the bare surface.

In countries such as North America, Scandinavia, Russia, etc., where one is more concerned with felling the timber of the primæval forests than with restocking the ground, all the regeneration that is often practised is by means of seed naturally carried from trees situated at a great distance from the cleared area. Under such circumstances anything approaching to a complete restocking of the ground with valuable trees cannot be looked for, as the seeds of the best trees, even when assisted by the most favourable winds, can only be carried for a few hundred yards. On the other hand, such light seeds as those of the birch, poplars, aspen, willows, etc., may be borne for many miles, and so it happens that when the coniferous forests of new countries are felled or burned, their place is taken by comparatively valueless trees.

In the foregoing pages, all the important systems of natural regeneration by means of seed have been touched upon. Care has been taken to avoid advancing mere theories, attention being entirely given to practical methods which have stood the test of long experience. There appear to be, however, unsurmountable obstacles in the way of any of them being made practically applicable to any great extent to British conditions. Natural regeneration is almost impossible where ground game is as abundant as it generally is in this country. Here, too, there are very few estates where woods are managed on a well-organised working plan, that is to say, there does not exist, nor can there under the system of private ownership, long sustained continuity in the administration of our woodlands. Fortunately several circumstances combine to place this country in an almost independent position as regards natural renewal. Our humid atmosphere does not make the preservation of soil-moisture by constant shading the paramount consideration which it becomes under the conditions of a continental climate, though in our drier districts it is still most important. Nowhere are our fertile valleys threatened by destructive avalanches of snow or earth consequent on clear-felling a mountain slope. All parts of the country are in good communication with railway systems, so that young trees, under the existing conditions of rapid transit and improved packing, can be safely and cheaply delivered almost anywhere. In cultivating conifers one should, in the absence of rank herbage, make use of untransplanted seedlings, and insert them, not with a spade, but with a single-handed planting-iron. In this way land may often be perfectly stocked at a cost not exceeding 12s. per acre, a sum generally exceeded by natural regeneration.

My conviction is that our foresters should very seldom indeed aim at a hard and fast system of natural regeneration, but while making use of all serviceable advance growth, should depend on artificial planting, or, under certain circumstances, on artificial sowing, as the mainstay of British sylviculture.

VI. *Old and Remarkable Trees on the Estates of Earl Spencer in Northamptonshire.* By F. MITCHELL, Forester, Harlestone, Northamptonshire.

The estates of Althorp and Harleston lie in the mid division of Northamptonshire, and are, geologically speaking, on the Oolitic formation. The soil varies from stiff loam to rich red loamy earth, resting on sandstone strongly impregnated with iron. Althorp Park comprises an area of about 550 acres, is well sheltered, and beautifully wooded, the surface rising and falling in gentle undulations. The soil generally is favourable for the production of large hardwood trees, and lies at an elevation varying from 320 to 450 feet above sea-level. The average annual rainfall being about 25 inches.

In the following report, the particulars are given of twenty remarkable trees on these estates, all of which stand within a mile and a half of Althorp House, the seat of Earl Spencer. There are a very large number of other trees standing in Althorp and Harleston Parks, which are worthy companions of the "monarchs" of the forest which are described in this report.

To a forester, one of the most interesting features in Althorp Park is the number of inscribed stones which stand in the woods and groves, and which commemorate the date when the plantations were formed. Evelyn refers to these date-bearing stones, and remarks, "The only instance I know of the like in our country." The stones are referred to hereafter in describing the positions of some of the trees. Here and there, however, in the woods which these stones mark the birth of, there are standing larger and much older trees, which must have been planted long before any of the dates mentioned on the stones. The earliest date is that on the stone standing in the old heronry, near the Hawking Tower, built by the first Baron Spencer, and which bears the dates 1567-1568.

Some of the trees stand so inconveniently for being photographed that nothing like justice has been done to their grand size and beautiful proportions, but the photographs in the accompanying album will give some idea of their shape, size, and beauty.[1]

The first sixteen trees are growing in Althorp Park, and the remaining four in Harleston Park. The twenty trees give an average of 722 cubic feet each, which indicates their great age.

[1] The album is placed for the inspection of members in the Society's library.—ED.

The measurements of each tree are given in a tabulated form at the end of this report, so as to be more convenient for reference.

1. Elm, English (*Ulmus campestris*).

This fine tree is growing in the pleasure grounds, 150 yards on the east side of the mansion. It has a grand bole, girthing 13 feet 6 inches, where it divides into two ponderous stems, and these divide again, one at 12 feet and the other at 16 feet, and afterwards ramify into several smaller ones, which tower away to the great height of 117 feet, forming a top 94 feet in diameter. It girths 21 feet 2 inches at 3 feet from the ground, and contains a total of 924 cubic feet of timber.

2. Chestnut, Horse (*Æsculus Hippocastanum*).

This is a beautiful tree, growing at the extreme north of the pleasure grounds, near the Wilderness. It is shut in very much by other trees, nevertheless it has a beautiful sweeping top 85 feet in diameter, with a bole of 10 feet in length, while at 3 feet up it girths 13 feet 8 inches, and at 5 feet from the base 14 feet 10 inches, and contains a total of 533 cubic feet of timber.

3. Beech (*Fagus sylvatica*).

A fine young park tree, growing close to the drive leading to New Lodge, near Althorp Park Station. It has a bole 36 feet 6 inches in length, with a nice well-balanced top 98 feet in diameter. It girths at 3 feet up 14 feet 8 inches, and contains 375 cubic feet of timber.

4. Oak, English (*Quercus pedunculata*).

This is one of the grandest old ornamental park trees to be found anywhere, and one of the largest in the park. It is growing on the east side of the mansion-house, and 150 yards from the boundary wall of the pleasure grounds, standing in full view from the drive leading to the east lodge. This picturesque old oak has suffered very much by severe gales, losing two very large limbs at 33 feet from the ground. The top is beginning to show signs of old age, and some of the topmost limbs are quite dead. At 3 feet from the base it girths 26 feet, and contains a total of 947 cubic feet of timber.

A stone standing near by bears the following:—

This Wood was planted by
Robert Lord Spencer
in the Year of our Lord
1602-1603.

5. Elm, English (*Ulmus campestris*).

A very remarkable tree, growing by the side of the carriage drive, and 200 yards from the front gates to Althorp House. The bole, at 12 feet from the base, divides into two very massive stems, and these separate into two each, one at 5 feet and the other at 8 feet; these again dividing into a number of smaller limbs, and towering to 105 feet high. It girths 23 feet 6 inches at 3 feet from the base, and contains 841 cubic feet of timber.

6. Cedar of Lebanon (*Cedrus Libani*).

Growing on a plateau on the south front of the mansion, called the Highwood, stands this very old weather-beaten tree. The top has suffered very much by past gales and snowstorms, having lost at one time or another no less than twenty large limbs. This grand old monarch, before losing so many of its limbs, must have contained upwards of 1000 cubic feet of timber. Its girth at 3 feet from the base is 20 feet 10 inches, and at 5 feet, 22 feet 2 inches; the top (what is left) has a diameter of 70 feet. Height of bole, 8 feet 6 inches, and the tree now contains 603 cubic feet of timber.

7. Wych, or Scotch Elm (*Ulmus montana*).

This is a very fine wych elm. It is growing at the top end of Blue Bank Plantation, close to the gas-house, between the mansion and the kitchen garden. This tree deserves a more prominent place than where it is. It is very much shut in by other trees, and cannot be seen until one is quite close to it. It has a clear bole of 20 feet, with a well-balanced top, 94 feet in diameter. At 3 feet from the ground it girths 19 feet 8 inches, and contains a total of 487 feet of timber.

On a stone standing near an inscription reads—

Planted by George John Earl Spencer K.G.
in the Year MDCCC.
to replace a grove of Ash fallen to decay.
"Uno. Arubro, non deficit Alter."

8. Oak, English (*Quercus pedunculata*).

A remarkably handsome park tree, growing on the side of a bank sloping to the north, towards the coach road leading to the west lodge. This grand specimen of an oak has one of the finest boles of any tree in the park, and growing as it does in a very prominent position, it shows itself off to great advantage. It is a very healthy-looking tree, and is adding to its girth yearly. The bole is 46 feet high, as straight as a gun-barrel, and it carries a nice well-balanced top of 87 feet 6 inches in diameter. At 3 feet up, it girths 21 feet 9½ inches. The bole alone contains 836 cubic feet, and the whole tree 933 feet of timber. £100 was offered for this tree during the Crimean War.

9. Oak, English (*Quercus pedunculata*).

This is another good tree, growing 50 yards from No. 8. It is of quite a different type, having some very large limbs, growing out from near the base. At 33 feet up it divides into two, and then goes straight away to the height of 94 feet. It girths 19 feet 10 inches at 3 feet up, and contains 655 cubic feet of timber.

10. Oak, English (*Quercus pedunculata*).

This tree, which stands in a line with No. 9, and 60 yards from it, is a beautiful specimen of a park tree. It has a healthy and vigorous-growing appearance, and will yet add a lot of girth to its already massive trunk. It has a grand, far-reaching, well-balanced top of 104 feet in diameter; a bole of 33 feet in height. At 3 feet from the base it girths 22 feet, and contains 582 cubit feet of timber.

11. Oak, English (*Quercus pedunculata*).

Another fine tree, standing 100 yards up the slope from the west lodge, and 60 yards from No. 10. It has a bole 30 feet 6 inches high, girths 19 feet ½ inch at 3 feet up, and contains 594 cubic feet of timber.

12. Cedar of Lebanon (*Cedrus Libani*).

This is a beautiful vigorous-growing tree, standing in a hollow in the orchard, below the kitchen garden. It is nicely sheltered on all sides, and has a fine bole 32 feet high, as straight as an arrow, and up to 28 feet it has not a branch on it. This promises to make a tree of large dimensions. It girths at 3 feet from the ground 16 feet 11 inches, and contains 345 cubic feet of timber.

13. Oak, English (*Quercus pedunculata*).

In the deer park, on a bank sloping to the south, on the west side of the mansion and near to the church path, grows this remarkable ornamental park tree, just the type of what an old oak should be. It has a very massive bole, 23 feet 6 inches in girth, where it divides into two ponderous stems. These again separate, one at 8 feet and the other at 9 feet, and then ramify into a number of smaller ones, giving a top 91 feet in diameter. Its trunk girths 21 feet 3 inches at 3 feet from the base; and the tree altogether contains the very large total of 1016 cubic feet of timber.

Near this tree stands a stone with the following inscription :—

This Wood was planted
By Sir William Spencer, Knight of the Bath,
in the Year of our Lord
1624.

"Up & be doing and God will prosper."

14. Oak, English (*Quercus pedunculata*).

This beautiful young oak is growing in the heronry at the top end of Sir John's Wood, in the extreme north of the Deer Park. It has a fine, straight, clear bole, 64 feet in length, and a vigorous-growing top, the whole rising to a height of 98 feet. This will doubtless make a very large tree, as it is adding to its girth at a rapid rate. At 3 feet from the base its girth is 12 feet 10 inches, and it contains 469 cubic feet of timber.

A stone in the centre of the wood, and 100 yards from this tree, reads—

This Wood was planted
By Sir John Spencer, Knight,
Father of Robert Lord Spencer
in the Year of our Lord
1589.

Standing in the old heronry adjoining this wood, and near the Hawking Tower in Althorp Park, a stone bears the following inscription:—

This Wood was planted
By Sir John Spencer
Grandfather of Robert Lord Spencer
in the Year of our Lord
1567-1568.

15. Lime (*Tilia Europæa*).

A remarkably fine specimen of a park tree, growing on a bank sloping to the north, and 270 yards south of the east entrance to Althorp Park. This is the upper tree of three limes growing in a line at 16 yards apart on rather shallow soil, a quarry, 25 yards from the trunk of the tree, showing the stone to be close to the surface of the ground. A finer specimen of a park tree than this is it would be hard to find. At a height of 10 feet 6 inches it divides into six large limbs, spreading out and giving it a diameter of top of 90 feet 6 inches, the lower branches sweeping all round close to the ground. It girths 17 feet 7 inches at 3 feet from the ground, and has a total of 575 cubic feet of timber.

In the Ice-House Plantation near to this tree there is a stone bearing the following inscription:—

Planted by George John, Earl Spencer, K.G.,
in the Year M.D.CCXCVIII.

"Seris Factura Nepotibus Umbram."

16. Ash (*Fraxinus excelsior*).

This remarkably grand tree is growing on the south side of the mansion, and close to the boundary wall dividing Althorp and Harleston Parks. This gigantic specimen of an ash has a bole 36 feet high, with some immense limbs spreading out on all sides, and gives a diameter of top of 92 feet. The trunk girths 17 feet 6 inches at 3 feet up; and the tree altogether contains 809 cubic feet of timber.

17. Elm, English (*Ulmus campestris*).

On the west of Harleston House, and just outside the flower garden in the park, grows this very fine elm. At 20 feet high it lost a very large limb in the gale of October 14, 1881. It has a good bole to 50 feet 6 inches, and towers to the height of 110 feet. At 3 feet from the ground it girths 20 feet, and contains 715 feet of timber.

18. Spanish Chestnut (*Castanea vesca*).

On the north side of Harleston House, and 60 yards from the kitchen garden, grows this grand type of an old ornamental park tree. It has a fine straight bole 20 feet high, dividing here into two enormous stems, these branching out again at intervals, and towering to the height of 90 feet. It has a beautiful well-balanced top of 85 feet diameter. It girths 26 feet 3 inches at 3 feet from the base, and contains the magnificent total of 1220 cubic feet of timber.

19. Spanish Chestnut (*Castanea vesca*).

At 25 yards away, and to the east of No. 18, stands this grand tree, and although somewhat dwarfed by its near neighbour, yet it contains 893 cubic feet of timber. It has a bole of 27 feet in length. At 3 feet from the base it girths 23 feet 4 inches, and has a spread of top 86 feet 6 inches in diameter.

20. Spanish Chestnut (*Castanea vesca*).

This is another remarkable old ornamental Spanish chestnut, growing 140 yards north of No. 19, on a rising bank facing the east, in an exposed situation. At 3 feet from the base it girths 24 feet 3½ inches. This tree has lost some immense arms; the largest broke off 5 feet from the trunk at 15 feet up in the gale of October 14, 1881. This arm girths at 3 feet from the bole 9 feet 10 inches.

At 12 feet from the ground an enormous limb grows out, curving its way upwards to 65 feet, and having quite an imposing appearance. At 3 feet from the bole this limb girths 10 feet 11 inches, the whole tree containing 924 cubic feet of timber.

TABLE *giving the Names, Dimensions, and Cubic Contents of the foregoing Twenty Remarkable Trees growing in Althorp and Harleston Parks.*

	Name of Tree.		Girth at 3 Feet from the Ground.		Girth at 5 Feet from the Ground.		Height of Bole.		Diameter of Top.		Total Height of Tree.	Cubic Contents.
No.	Common.	Botanical.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	Ft.
1	English Elm, .	*Ulmus campestris*, . .	21	2	20	0	13	6	94	0	117	924
2	Horse Chestnut, .	*Æsculus Hippocastanum*,	13	8	14	10	10	0	85	0	83	533
3	Beech, . . .	*Fagus sylvatica*, . .	14	8	12	6	36	6	98	0	76	375
4	Oak, . . .	*Quercus pedunculata*, .	26	0	22	4	33	0	85	0	81	947
5	English Elm, .	*Ulmus campestris*, . .	23	6	19	8	12	0	95	0	105	841
6	Cedar, . . .	*Cedrus Libani*, . .	20	10	22	2	8	6	70	0	70	603
7	Wych Elm, . .	*Ulmus montana*, . .	19	8	16	1	20	0	94	0	100	487
8	Oak, . . .	*Quercus pedunculata*, .	21	9½	19	4	46	0	87	6	82	933
9	Oak, . . .	,, ,, .	19	10	18	0	30	0	94	0	81	655
10	Oak, . . .	,, ,, .	22	0	18	3	33	0	104	0	74	582
11	Oak, . . .	,, ,, .	19	0½	16	3	30	6	90	0	79	594
12	Cedar, . . .	*Cedrus Libani*, . .	16	11	15	1	32	0	74	6	80	345
13	Oak, . . .	*Quercus pedunculata*, .	21	3	19	7	23	6	91	0	88	1016
14	Oak, . . .	,, ,,	12	10	12	4	64	0	69	6	98	469
15	Lime, . . .	*Tilia Europæa*, . .	17	7	17	1	10	6	90	6	79	575
16	Ash, . . .	*Fraxinus excelsior*, .	17	6	16	1	36	0	92	0	80	809
17	English Elm, .	*Ulmus campestris*, . .	20	0	18	6	50	6	86	6	110	715
18	Spanish Chestnut,	*Castanea vesca*, . .	26	3	22	8	20	0	85	0	90	1220
19	Spanish Chestnut,	,, ,, . .	23	4	20	8	27	0	86	6	85	893
20	Spanish Chestnut,	,, ,, . .	24	3½	22	9½	28	0	70	6	68	924

VII. *The Formation of Plantations.* By A. C. Forbes, Assistant Forester, Lintmill, Cullen.

Introduction.

The great length of time which must ensue before any adequate return can be expected from newly-formed plantations in this country probably accounts for a great deal of the apathy and indifference with which the majority of landed proprietors look upon their waste ground and worn-out woodlands. Even the majority of those who do plant are probably actuated more by a desire to beautify their estates, provide shelter for game or against wind, and generally add to the value of their property, than with any definite idea that the money expended in planting and maintenance will ever be repaid with interest. Although planting with the former objects in view is free from any objection from an æsthetic standpoint, or when considered by themselves, yet it will be admitted by every one versed in rural economy that planting without due consideration of the profit and loss principle does not produce such satisfactory results as should be desired. Just as we find the careful and intelligent farmer, who carries on his business on strictly economical lines, more permanently benefiting himself and the country generally than the gentleman farmer who sinks hundreds of pounds in high-class and extravagant farming, so we can easily see that the proprietor who never throws money away in planting ground with unsuitable plants, or which is unsuitable for planting at all, will be more likely to permanently increase the value of his property, benefit the local population, and give a better appearance to his estate generally, than another who merely aims at producing game cover, or a mass of foliage which can only be called pleasing when viewed from a distance.

In support of these ideas, we have only to visit such estates as those belonging to the Dukes of Athole, Portland, Bedford, Lords Mansfield, Seafield, Lovat, and many others in the United Kingdom, and we find that their most attractive features, prosperous appearance, and influence on the local trade and population, are largely due to the careful and practical manner in which their woods have been managed for many years.

The explanation of these facts must be obvious to all, when we consider that a healthy plantation simply means a mass of healthy trees. A man needs little or no knowledge of forestry to enable him to discriminate between a thriving and healthy tree and a diseased and stunted one; and every true artist will admire the former before the latter, because the healthy tree is the typical production of the great artist herself—Nature, the source of all art. Now every practical forester knows that a healthy and vigorous growth can only be insured by the careful selection of those plants which are thoroughly well adapted to soil, climate, and situation. Although it would perhaps be going too far to say that indigenous plants can alone supply what is required in this respect, yet when we consider the various diseases and climatic affections to which introduced trees are subject in this country, coupled with the fact that they rarely retain their timber qualities when removed from their native habitat, we may safely infer that if we want to see a healthy and vigorous growth maintained throughout the lifetime of our plantations, we must content ourselves with those species which nature has provided with a constitution strong enough to withstand our changeable temperature and uncertain climate, and leave recent introductions outside the bulk of our woods until careful experiments in various soils and situations have determined their particular requirements in these respects.

And with regard to the third point, viz., their relation to local industries, the importance of healthy woods is made still clearer. We usually find that any industry which owes its existence to the manufacture of articles of commerce from or out of the raw material, is located in the neighbourhood from which the raw material is obtained. The reason for this is obvious, and needs no explanation. Now, although the industries connected with woods in this country are comparatively unimportant when considered individually, yet when taken collectively we find that they occupy a more important place in regard to the prosperity of the country than would at first sight appear. It is true that woods neither bring in money nor employ much labour for the greater part of their growth, but this is exactly the period in which they exercise the most beneficial effects on the adjoining agricultural lands. Their relation to climate, rain-fall, water-supply, etc., is also considerable, but which can only be merely referred to here. But during their formation and earlier stages, and the final cutting and disposal of the timber, they give employment to many hands, and at a time of the year when employment is often much needed. The formation of a plantation necessitates the performance of various operations in the way of draining, fencing, planting, etc., all of which give work to a large number of men, and also benefit more or less directly various tradesmen, railway companies, and others, according to the extent of the work. At the final cutting, again, in addition to the labour required for that operation, the manufacture and removal of the produce gives considerable employment to a large number. Woods also give rise to many minor industries in their immediate vicinity, such as hurdle-making, broom, clog, bobbin, and chair making, charcoal-burning, etc., while the more recent use of wood in the manufacture of paper may cause early thinnings to become of greater value than they have hitherto been.

We thus see that woods of any kind play an important part in the prosperity of a rural district; but it is only when the true principles of forestry have been observed in their management that the greatest benefits derivable from plantations are obtained. It is a recognised fact that only timber of good quality and clean growth will command a fair price in the market; and if home-grown timber lacks these conditions, the merchant supplies himself with a better class of timber imported from abroad, thereby sending out of the country the money which might have been circulated within it. The question as to how long this importation of foreign timber may continue at its present rate is exercising the minds of many of our political economists of the present day, but it appears to be generally admitted by those best qualified to give an opinion, that if we should ever require to turn our own woods to account in the event of a timber famine, a more scientific and economical system of management will have to be adopted than has hitherto existed in this country.

Laying off the Boundaries.

When it has been definitely decided to form a plantation, the marking off of the boundaries should be the first operation to be performed. In planting old agricultural land, the existing size and shape of the fields are usually retained, except, perhaps, where the outlines are too formal or irregular, and require rounding off or otherwise modifying to suit the taste or requirements of the proprietor. When formed solely for the purpose of giving shelter to adjacent lands, however, it is sometimes necessary to lay off fresh boundaries altogether, in order to break as much of the wind as possible, and give shelter to a larger area. As winds usually acquire their objectionable character from the surface over which they have previously passed, whether snow-covered mountains, hot deserts, or wide oceans, it is evident that the wind most dreaded in one locality may be perfectly harmless in another, although coming from the same quarter of the compass; therefore no general rule can be laid down as to the particular direction in which a shelter-belt should extend, all depending upon the direction from which the wind comes that it is desired to break. The shape of the belt must depend a great deal upon the extent of ground it is intended to shelter, and the conformation of the ground. When it is intended to give thorough shelter to a limited area, that of an acute angle is probably the best, with the apex presented to the wind. When given such a shape it has a greater tendency to divert the current of air in two directions, one along each side of the belt respectively; and it also gives more efficient shelter to the ground immediately to the leeward of the belt, by protecting the two sides nearly parallel to the direction of the wind, forming a cove or recess, an invaluable situation for pasturing cattle. When it is desired to shelter a larger area without increasing the size of the belt, the angle may be increased until it results in nearly a straight line, the convex side of which should always be presented to the wind, otherwise it would have a tendency to concentrate the force of the wind into the corner formed by the junction of the two sides, thereby increasing its force at that particular spot. The length of such a belt is indefinite, according to the requirements and extent of the ground to be sheltered, but the breadth at the point of impact should never be less than from one to two hundred yards if it is intended to produce timber, and either retaining that breadth throughout, or gradually decreasing towards the leeward extremities.

In laying off plantation boundaries which are intended for the production of timber, we have to be guided by different principles. Here we have to consider how best to prevent strong or prevailing winds from injuriously affecting the health and growth of the trees and uprooting them after a severe frost or heavy rain, both of which loosen the ground and render the trees more liable to be overturned. So long as a plantation remains intact, and is not weakened by injudicious thinning, we rarely find that winds do much damage in the way of uprooting, but that they have a great influence on the health and growth of the trees is a well-known fact. Indeed, in wind-swept situations we have only to notice the shape of individual trees that stand alone to ascertain from which direction the prevailing winds come. The windward side of such trees is rounded off as if trimmed with a knife, while the branches on the opposite side are longer and more vigorous. This is more especially noticeable near the sea, where the wind is laden with salt from the ocean, and which few trees can withstand with impunity. Seeing that the wind has so much effect on the growth of trees in exposed situations, it is evident that the smaller the surface presented to the wind the less will its influence be felt. To secure this desideratum, it is clear that we must follow to a certain extent the plan adopted in the case of shelter-belts, and by presenting a barrier to the prevailing wind endeavour to shelter the bulk of the plantation in somewhat the same way as the fields were sheltered in the former case. We notice that the trees on the extreme edge of a plantation exposed to strong winds are always the smallest and most stunted, in consequence of having to stand the full brunt of the blast. The second row back is less affected than the first, owing to the shelter afforded them by the latter, and we find them a foot or two higher, and with their tops leaning away from the wind. The next row presents a similar appearance, but taller than the second; and so we find the trees gradually getting taller as we penetrate deeper into the wood. It is evident, from the inclined plane presented by the tops of the trees collectively, that the wind, when coming in contact with the edge of the plantation, is forced upwards until it reaches the average level of the tree-tops (where it meets with no opposition to its horizontal course), and only falls to its former level again when it has passed the limits of the plantation. To satisfy ourselves on this point we have only to stand on the leeward side of a wood in windy weather, and so long as we are under the shelter of the trees we feel little or nothing of the force of the wind, but the farther we retreat from the wood the more we experience its effects, until we get to such a distance from it as to render its sheltering influence altogether imperceptible. Such being the case then, it is evident that when once forced to the top of a mass of wood, the wind cannot again fall until an opening occurs in the wood itself, or it reaches the open country.

In the case of a plantation on a hill-side, however, which faces the wind, this forcing upwards is continuous until it reaches the summit, and each tree being higher than the one immediately standing below it, owing to the rise of the ground, the wind has almost the same effect on the whole of the plantation as it had on the edges of the one standing on level ground.

In forming a plantation on a hill-side, then, we cannot protect the trees from the wind by giving the outlines any particular shape, but merely prevent it from acting on individual trees as much as possible by keeping them as close, and the whole of the plantation as perfect and free from gaps as possible. But on flat ground we can do something to lessen the effect of the wind by presenting as small a surface to the point from which it comes as possible. The most effectual method we could adopt would perhaps be that of giving the plantation an oblong or conical outline, with the shorter sides or the apex facing the wind; but such outlines would be too lengthy, and increase the expense of fencing, while they would probably be considered too formal for making a pleasing feature in the landscape. Perhaps the one most likely to suit all conditions is that of a triangle, with the apex facing the wind, as in the case of the shelter-belts, and for the same reasons. Of course gales do not always blow from the same point of the compass, and therefore we should guard against them as much as possible on all sides; but as this is a matter more closely connected with planting and thinning, we think the prevailing winds should receive most consideration when laying off a plantation intended for the production of timber, as they affect the growth and health of the trees to a greater extent than the others. To endeavour to make the boundaries as short as possible, and the avoidance of unnecessary curves and corners, are important points where economy is aimed at, as the fencing of the ground is always an expensive item, especially when compound interest has to be charged for a number of years on the original outlay. Generally speaking, the size and shape of plantations should conform or agree as much as possible with the surrounding country.

Fencing.

The expense incurred in fencing and draining ground before planting can be proceeded with probably deters many proprietors from planting more of their waste ground than they do at present.

Were it not for the necessity of fencing, there is little doubt that many odd corners and waste patches of ground to be found on every estate would be utilised in growing timber, but owing to the fact that such pieces of ground are usually of a very irregular shape (generally consisting of narrow strips by the roadside, or small ravines), the length of fencing that would be required would be out of all proportion to the area enclosed, and therefore we rarely find such ground planted unless for shelter. In forming extensive plantations, however, the larger the area enclosed the smaller the cost per acre, providing judgment is exercised in laying off the boundaries; but even then it always forms one of the most expensive items, and should be done at as little cost as is consistent with durability.

In planting extensive tracts of moorland or hill-sides which are not depastured with sheep or cattle, fencing may sometimes be dispensed with altogether, or only carried out on the sides liable to encroachment; but generally speaking, it is rarely safe to omit taking full precautions against any possible damage to the young plants, as any such omission may result in serious injury to the plantation.

Plantations to be formed in the midst of agricultural or grazing ground must be thoroughly and efficiently fenced on all sides, and the most economical fence for general plantation purposes is probably the turf dyke, surmounted by a low post and wire fence. The dyke should be 3 feet high (at the base of which a ditch should run 2 feet deep by 3 feet wide at top), and should be substantially formed of sods or turfs containing as little organic matter as possible, the outside face being made almost perpendicular, the inner sloping away gradually. It must be allowed to settle down properly before the wire fence is erected, or the posts will not take a firm hold of the ground, and when the fence is erected it should not stand nearer the edge of the dyke than 12 or 18 inches. The posts should be larch, $4\frac{1}{2}$ feet long, and not less than 2 inches in diameter at the small end, and should stand $2\frac{1}{2}$ feet above the top of the dyke. As the posts decay rapidly in dry dykes, the wooden straining posts should be replaced by iron pillars erected every two or three hundred yards in the straight parts of the fence, and at any corner or bend where required. This will increase the cost of the fence at the outset, but will prove the most economical in the long run, as the iron pillars will last for many years if kept varnished or painted.

Three No. 7 wires will be sufficient, fixed to the posts by staples, and strained by means of brackets fixed on the iron pillars, double brackets being attached to every other pillar for that purpose. The larch posts should be soaked in creosote or tar after they are thoroughly dry before being used, as when so treated they will last considerably longer than unprepared ones. A fence of this kind, dyke included, will cost from 8d. to 1s. per yard, and if well put up the expense of maintaining it will be comparatively trifling, as after a few years decayed posts may be renewed from the thinnings of the plantation, thus avoiding the necessity of carting from a distance.

Should the soil be suitable, and the situation favourable to its growth, a thorn hedge may be planted on the inside of the fence, and, if properly attended to, will be sufficiently strong to take the place of the latter by the time the posts have decayed; but all overhanging branches must be kept cut back, or it will become weak and patchy. In such a case the iron pillars may be dispensed with, and wooden strainers used instead.

Various other kinds of fences are in use throughout the country, such as stone dykes, slate, posts, and hoop-iron, and hedges of all descriptions; but the style most commendable for a plantation depends upon the locality in which it is erected, proximity and cost of materials, skill possessed by the workmen employed, and whether intended to be permanent or only temporary; and therefore all these particulars must be taken into consideration before any description of a fence can be recommended in preference to another.

Draining.

In no operation connected with the formation of plantations is more judgment necessary than in draining, for if imperfectly or carelessly done, it often fails to produce any of the good results expected from it, while one drain in the right place may be more effectual than a dozen in the wrong. The first thing to be ascertained is the extent of ground which really requires draining, for it is seldom that the entire surface of an extensive piece of ground is too wet for the healthy growth of trees, and therefore all unnecessary draining should be avoided as much as possible. The natural vegetation affords a pretty good indication of the nature of the surface soil in this respect, and should be carefully noted. It will generally be found that where the natural vegetation is healthy and flourishing, the soil itself is in a fairly good condition, both chemically and mechanically, or at least so far as uncultivated ground can be expected to be. But the natural vegetation usually consists of plants best fitted to exist under those conditions of soil and climate in which they are found, and therefore the fact that the indigenous plants are thriving is no criterion by which we can prove that the trees we wish to plant there will thrive too, unless we know that the latter thrive under the same conditions as the former. If we know this, we can assume that the ground is in a comparatively fit condition for the plants we wish to introduce, and draining is therefore unnecessary, but where the vegetation indicates a condition of soil known to be unsuitable to the plants we wish to stock the ground with, then we must endeavour to remedy this unfavourable condition if possible.

On the other hand, when the soil is in a sour, unhealthy condition, the vegetation invariably indicates it. If we notice the heather growing on a wet piece of moorland, with an underlying stratum of moor-pan, we usually find it stunted, sickly, and covered with lichens, so that we come to the conclusion that something is necessary to put it in a more satisfactory state, and the removal of the superfluous moisture will be the first consideration.

The first point to be considered in commencing to drain, is the outlet which will have to carry off the whole of the discharge from the drains connected with it, and if possible this should always lead into a natural water-course or burn, as all further trouble is thereby avoided in getting rid of the water, providing the natural channel is sufficiently wide and deep to carry off the additional water. It is not necessary for all the drains to have the same outlet, as in hilly and undulating ground this would be practically impossible; but on flat ground, or where the fall or slope is very slight, the lowest part of the ground must be the point for the outlet, which should be carefully ascertained by means of the theodolite and levelling rods, as guess-work is often very risky in regard to this point. The outlet having been decided on, a main drain (or several, if required) should be cut from it to the farthest extremity of the ground that requires draining, giving it a few inches more depth than the sub-mains running into it. The main drain, and all others in fact, should be perfectly straight if the surface of the ground permits, but if not, it should take such a course as will ensure a gradual and uniform fall from its commencement to the outlet, which must depend upon the slope of the ground, but from 1 in 150 to 1 in 200 is quite sufficient to ensure a steady flow, which is less liable to injure the sides of the drain than a more rapid fall. The depth should be from 3 to 4 feet according to the nature of the soil, the depth it is intended to make the sub-mains and laterals, and the quantity of water it will be likely to receive. The sides of the drain should have a slope of 45° if the soil is at all loose or friable, but less than that will be sufficient in clay or adhesive soil, and it should have a width of 1 foot at the bottom, the sides being neatly dressed, and made firm with the back of the spade. The sub-mains should be cut on the same principle as the main, but will not require to be so deep or wide, their dimensions being in proportion to the number of laterals running into them, and the state of the ground. The fall for these should be slightly greater than that of the mains, as their efficiency depends on their carrying off the water rapidly and thoroughly, and they are more liable to get choked with leaves and débris than the larger drains. Two drains from opposite sides of the main should never run into it at the same point, as when the flow is at all rapid, leaves and rubbish are brought down and deposited at this point, and tend to prevent the free flow of the water ; but a slight curve should be given them just before they enter the main, where there is any probability of a rapid flow, in order to prevent the water from washing into the opposite bank.

The method of draining the main portion of the ground by means of the lateral drains, must depend upon the cause of wetness and the nature of the soil. When the superfluous moisture is caused by springs, thrown out by an impervious substratum, and spreading over the surface of the ground, a deep drain should be cut along the line of the outbreak (which can easily be seen by the state of the ground), so as to catch and carry away the water before it has spread over the surface. This will sometimes succeed in drying the ground below the drain, but much will depend upon the depth and arrangement of the strata through which the drain is cut. Sometimes the moisture is due to the impervious nature of the surface soil, such as clay or moor-pan, and should this rest on a porous bottom a few deep drains reaching to the porous bed will carry off much of the water, and render a main unnecessary. This is an important consideration on flat ground, where there is a difficulty in getting a proper fall, and should always be taken advantage of when possible. When the wetness is due to the retentive nature of the ground, as in clay soils or peat bog, a thorough system of lateral drains must be carried out. These are usually placed at the distance of from 20 to 30 feet apart, and should be cut with their sides perpendicular, as they are thus less likely to be beaten down by heavy rains, which fill up the interstices of the soil, and prevent the water from percolating through them freely. Their depth is usually about 18 inches to 2 feet, according to the requirements of the intended crop, coniferous trees requiring less depth of soil than hardwoods, as their roots do not penetrate so far into the soil as those of the latter. Where the ground slopes, the laterals should be cut at a more or less acute angle with the mains, in order to secure a proper fall, but the nearer they approach to a right angle with the main, the greater will be the area drained in proportion to their length. As before stated, all unnecessary drains should be avoided, while in extra wet places they may be cut closer than the usual distance, just as they may be required.

In draining undulating ground, it is sometimes impossible to carry off the water by means of a main without going to great expense in cutting a drain far deeper than the average. Such a case occurs where the ground slopes from all sides, and forms a hollow, when, to carry off the water, a drain would have to be cut through the surrounding ground until a lower level was reached. It is obvious that the expense incurred in doing this would be out of all proportion to the return expected, and therefore it would be more economical to run all the drains into the hollow, and allow it to form a pool. Should, however, a porous stratum exist within a reasonable distance of the surface of the hollow, a hole cut down to it will carry off the water before it has time to accumulate. On very flat ground, where a fall cannot be obtained, or where it is so slight as to be practically imperceptible, the best thing to do is to cut deep ditches at regular intervals, in which much of the water will collect, and leave a sufficient depth of drained soil to enable certain species of trees to succeed fairly well.

Such are the principal and most frequent cases which occur in draining plantation ground, but exceptional ones may arise which will require special methods of treatment, but which it is not necessary to describe here.

Preparation of the Ground.

It seldom happens that waste ground can be planted without some preparatory operations being found necessary to secure a favourable start for the young plants. The soil may need breaking up where too hard, or the natural vegetation require removing, or both of these operations may be necessary before planting can be proceeded with.

On heathy ground, moor-pan is the most frequent obstacle to the healthy growth of trees, and it must be broken up before they are planted. Moor-pan occurs in gravelly soils containing a large quantity of oxide of iron, which, when in combination with water, forms a hard solid stratum, through which tree roots are unable to penetrate, and being impervious to rain, it often causes swamps. Moor-pan is usually broken up by means of an implement called a foot-pick, which is familiar to every forester in the north. It must be driven in under the pan if possible, as little good will be effected unless it is thoroughly broken up. This should be done a considerable time before planting is performed, so that the atmosphere may act upon and sweeten the soil, and decompose any inert matter contained in it. Hard gravelly soils are also benefited by the above operation, and the extra expense incurred is generally compensated for by the growth and vigour of the plants compared with those planted in unprepared ground.

When pitting is intended, which is usually adapted for hardwoods, the pits may be opened six months or more before they receive the plants, as the soil is thus pulverised by frost, and chemically acted upon by the atmosphere. In wet soils, however, they are apt to fill with water, and in such cases are better left until the time for planting arrives.

Of natural vegetation, whin or furze is probably the most troublesome to keep down until the plants are out of all danger of being smothered. They should be burnt, and the big stumps grubbed out as low as possible, as it is the growth from these old stumps that proves the most troublesome to deal with, and after the plants are in, burning is out of the question. Some recommend cutting out lines through the whins, and trenching the soil. This would give the plants a better chance of succeeding and growing out of danger; but in badly-infested places they would still require to be kept down by cutting. Burning should be done about the middle of June, after the seeds have germinated, and before the pods are ripe on the old plants; and when done about this time it leaves the roots in a weaker condition than when done in winter.

Long, rank heather will also require burning off, and this should be done three or four years before planting, if possible, as short heather is beneficial to the young plants by protecting them from the sun and frost.

Long grass must also be removed at or before the time of planting, where it has formed a close matted turf. Such turf intercepts and appropriates both dew and gentle rain, and none but the heaviest rains penetrate it, therefore plants inserted in it by notching invariably die in the event of a dry summer succeeding the planting season, especially in light dry soils. This is best removed some time before planting, so that the soil may be well soaked and softened by rain. The turf should be entirely removed with a spade, leaving a bare space about 9 inches square on the site intended for the plant, and if the soil is broken up at the same time, so much the better.

On dry, heathy ground, a dry inflammable sort of peat often gathers on the surface, which is very unfavourable for nourishing most plants, and in which trees never thrive until their roots have reached the soil beneath. Where such exists, it must be removed in the same way as the turf, unless it is too deep to be removed in that way, when the subsoil should be brought to the surface, and spread over the ground to a depth of six inches or so, which will be sufficient to grow Scots fir and birch. Although it may be too expensive a process for carrying out on a large scale, yet it is not more so than planting such ground without any preparation, with the result that the plants never grow into anything larger than a stunted bush. Peat of the same description, but wet instead of dry, is equally unfavourable to healthy growth, and must be treated in the same way, providing, of course, that the subsoil is capable of growing timber, as if not, the ground had better remain unplanted. Brambles, thorns, brackens, and all other rubbish must be cut, and cleared off the ground before planting commence, so that nothing may interfere with the progress of the work.

Choice of Plants.

This is one of the most important and difficult questions which the forester has to decide when forming a plantation, for although comparatively easy to choose species that will grow and make cover, yet when the problem of producing the most valuable crop of timber in the least possible time has to be solved, it is one that requires considerable foresight and judgment.

To ascertain beforehand the exact capabilities of the soil and situation is nearly impossible, although in many cases it may be done with some degree of accuracy, and the only way it can be accomplished, apart from chance, is by carefully noting the soil and situation of existing plantations, and their condition as to health and growth.

Altitude, climate, and exposure have probably more to do with the growth of trees than even soil itself (although the latter has a great influence on the quality of the timber), therefore the situation of the ground in regard to the first-named conditions must receive due consideration. As before pointed out, indigenous trees are more likely to turn out successfully from an all-round point of view, and give better results than those introduced from higher or lower latitudes, or from countries possessing different climatic conditions to those of our British Isles. It is true that exceptions to this rule may be found in many healthy and thriving plantations, composed of larch, spruce, and other introduced trees, but these are only found where the situation, soil, etc., are exceptionally favourable to their growth, and in such cases no objection can be found to their having been planted. But the miserable appearance presented by so many plantations of larch in different parts of the country proves the folly of planting these trees indiscriminately, and without duly considering the conditions requisite to bring them to maturity. Mere volume of wood, too, is often taken as the standard by which the timber qualities of different trees are compared with one another, but quality should be synonymous with strength and durability, and unless the timber possesses those qualifications, its market value will be comparatively small, and most of our introduced Coniferæ obtain their rapid growth at the expense of quality of timber, and therefore nullify any advantage they might otherwise gain over indigenous trees.

Considerable caution should be exercised, therefore, before foreign introductions are extensively planted, in order to see that the conditions under which they will have to exist are such as are known to be favourable to their healthy growth and the production of good timber.

Deciduous trees (with the exception of birch, alder, and aspen) should never be planted in any situation in which they are known to grow slowly and unprofitably, as their timber value is usually in direct proportion to the rapidity of their growth, *ceteris paribus.* Coniferous trees, on the other hand, generally produce better timber when their growth has been slow, and are therefore better adapted for planting at high altitudes, although they take longer time to come to maturity. In this country (Scotland) timber of any kind can hardly be profitably grown over 1500 feet above sea-level, and, in the vicinity of the sea, that altitude is probably too great. Much depends, however, upon the latitude; the nearer the equator the greater the altitude at which plants will grow. Climate is perhaps the most important factor in vegetable growth, for the elements of cold, heat, light, and moisture come under its head. More especially must it be considered in relation to all introductions from other countries, for it is the only important distinction which exists between different countries, and therefore powerfully affects plant life when moved from its native habitat. Owing to the insular position of Great Britain, it enjoys a warmer and more temperate climate than many countries which lie between the same degrees of latitude; but although it possesses the advantage of being usually free from extremes of cold and heat, it has the disadvantage of being very variable, especially during the spring months, when vegetation is very susceptible of atmospheric influence. In consequence of this, introductions from countries possessing more regular and equable climates than ours are often excited into growth by a spell of mild weather during March and April, and in the event of this being succeeded by a few days of cutting wind, or frosty nights, the effect on such plants is very injurious, and often engenders disease and unhealthy growth. This is frequently noticeable in the larch and silver fir, as shown by the unhealthy condition of their foliage, and the consequent attacks of aphides and other insects which generally accompany a weak and sickly growth. To prevent the result of this excitability as much as possible, such trees should be planted in situations where the variations of temperature are felt as little as possible, such as on slopes facing the north, cool soils, or in any other situations where the plants would be less likely to start early into growth.

Duration and intensity of sunlight also exercise a great influence on tree growth, especially in regard to the proper ripening of the wood. Trees like the larch, which continue growing late into autumn, cannot fail to be injuriously affected by a cold wet period during the months of September and October, as the young growths do not ripen properly, and are often destroyed by frost in the event of a hard winter succeeding such an autumn. Although rot in the wood of the larch is usually attributed to the condition of the soil, yet it is probable that improperly ripened wood may have equally as much to do with the disease; while it appears to be almost a certainty that the blister so common in this tree is the effect of the same cause.

The requirements of different species in respect to light should be well understood by the planter and thinner, as the mixing and mode of planting and thinning a plantation in a judicious manner depends a good deal on an accurate knowledge of this subject. Trees which require a considerable quantity of light for the development of their branches do best when planted by themselves in masses, as if mixed with shade-bearing trees, the latter would be apt to crowd them out if both classes were of the same age. In growing oak on dry soils, however, its own shade is sometimes insufficient to keep down weeds and rubbish, which impoverish the soil by appropriating much of its plant food, and in order to prevent this, beech is sometimes recommended for planting under the oaks, when the latter have reached a height of 50 or 60 feet, and have received their final thinning, which has the effect of increasing the leaf canopy and enriching the soil. The same system might be adopted in regard to ash, as although the soil suitable for growing ash is of a damp nature, yet a greater crop of wood might be obtained from the ground than would be the case if the space beneath the trees remained unoccupied. Spruce or silver fir, however, should be substituted in place of beech, as the latter is of little value when small, and ash coming to maturity far quicker than oak, would not allow time for it to grow to any size. Oak, ash, larch, and Scots fir are the principal light-demanding trees; while beech, hornbeam, silver fir, and spruce grow well under shade.

The annual rainfall of the district, considered in connection with the character of the soil, should influence our choice of plants to a certain extent. A porous, sandy soil is usually better suited for growing trees in a district with a heavy rainfall, than one of a cold retentive nature. In a moist atmosphere evaporation from the leaves is reduced to a minimum, and therefore the quantity of moisture required from the soil is comparatively small, while dry soils are more favourable to the development of fibrous roots than heavy ones, providing sufficient moisture is present to hold in solution the mineral matter required by the plant.

The amount of frost which may be expected in any situation must be anticipated before planting tender species, especially those which do not ripen their wood thoroughly. The young growths of larch and oak are often cut back by frost, although the latter tree is less likely to be permanently disfigured by the loss of a leader than the former, owing to its stem ultimately becoming straight by the way in which its annual layers of wood are deposited.

For exposed situations those plants should be selected which are known to withstand strong winds with impunity, and, at the same time, those avoided which become crooked and stunted in such situations. In situations near the sea, the saline-breeze has to be reckoned with, which greatly reduces the list of suitable trees. The most suitable trees for inland exposure are the Austrian pine, mountain pine, Scots fir, aspen, willow, sycamore, mountain ash, birch, etc. All species will grow when in masses, but the above-named should occupy the most exposed places, according to the soil and situation for which they are respectively adapted. Spruce and silver fir stand the wind well as far as growth is concerned, but the former is easily overturned by gales, and should never be planted on the margins of plantations. A belt of copse-wood or bushy growing trees, such as the mountain pine, mountain ash, hazel, thorn, birch, etc., planted round the margins, would be beneficial in exposed situations by preventing the wind from sweeping in under the taller trees, drying the surface, and carrying away fallen leaves, which latter are of great importance in poor dry soils.

As growing timber near the sea is almost an impossibility, plantations formed near it are usually only intended for shelter, and therefore such species should be selected as will grow best, independent of their timber qualities. The sea buckthorn is an invaluable plant for the exposed margin of such plantations, and if hedges or lines of it were planted two or three years before the other plants were put in, it would doubtless be found a great aid in giving them a fair start, which is the most difficult part in the formation of these plantations. The most suitable plants are the deciduous trees enumerated above, and the following conifers :— the Austrian, mountain, and Corsican pines, and, if slightly sheltered, the Scots fir.

Although it is almost impossible to accurately predict the trees which will succeed best in any particular soil, yet a careful examination of the latter is indispensable when making a judicious choice of plants. The natural vegetation is usually a pretty good indication of the character of the surface soil, but is not always a safe criterion by which to judge the subsoil. Thomson's "Gardener's Assistant" (p. 38) gives the following list of plants that have been observed to grow naturally on different descriptions of soils:—"Argillaceous—*Tussilago Farfara*, *Potentilla anserina*, *P. argentea*, *Orobus tuberosus*, *Lotus major*. Calcareous—*Veronica spicata*, *Campanula glomerata*, *Onobrychis sativa*, *Lithospermum officinale*, *Nepeta major*, [*Clematis vitalba*]. Silicious—*Silene anglica*, *Arenaria rubra*, *Veronica verna*. Peaty—*Vaccinium Myrtillus*, *V. uliginosum*, *Oxycoccus palustris*, *Calluna vulgaris*, *Erica cinerea*, *E. Tetralix*, *Spergula subulata*, *Tormentilla erecta*, *Empetrum nigrum*, *Eriophorum vaginatum*, *E. polystachyon*, and *E. angustifolium*, *Sphagnum obtusifolium* and *S. acutifolium*; *Rumex acetosella* indicates a peaty irony soil. Very dry soil—*Galium verum* and *G. saxatile*, *Aira praecox*, *A. caryophyllea*, *A. cristata*, *Hieracium pilosella*, *Arenaria rubra*, *Thymus serpyllum*, *Trifolium arvense*. Wet infertile soil—*Juncus squarrosus*, *J. acutiflorus*, *Cnicus palustris*, [*Pinguicula vulgaris*, *Triglochin palustre*], various species of *Carex*, *Hippuris vulgaris*, *Epilobium tetragonum*, *Lythrum salicaria*, *Ranunculus lingua*, *R. flammula*, *R. acris*, *R. bulbosus*, *Rumex acetosa*, *R. crispus*. Wet, but not necessarily infertile—*Poa aquatica*, *Alopecurus geniculatus*, *Veronica Beccabunga*, *Juncus conglomeratus*, [*Aira caespitosa*, *Cardamine pratensis*]. Fertility—*Cnicus lanceolatus*, *Urtica dioica*, *Stellaria media*, *Dactylis glomerata*, *Poa trivialis*. Cold subsoil—Of this, *Equisetum arvense* is peculiarly indicative."

When it is intended to plant shallow-rooting coniferous trees only, such as Scots fir, larch, and spruce, the character of the subsoil is of less consequence, as their roots rarely penetrate to a greater depth than 18 inches or 2 feet; but hardwoods, especially oak and ash, send their roots deep into the ground, and the subsoil has a greater influence on their growth than on the growth of the former. In many cases the surface soil is formed by the disintegration of the rock upon which it lies, and therefore the character of the subsoil can be easily seen; but in alluvial and diluvial deposits it is often of a totally different character, gravel and clay frequently lying in juxtaposition. All such formations, therefore, should be examined by digging holes here and there over the ground, and the subsoil noted down. The soil is rarely found to be of the same nature over any large area, and therefore the species should be distributed so as to suit the different soils, according to the elevation, exposure, etc.

All soils may be roughly divided into three classes, viz.—argillaceous, arenaceous, and calcareous, all presenting fertile and infertile examples, according to their mechanical condition, composition, and depth, and an attempt will be made to briefly show the most suitable trees for each class.

Argillaceous.—These consist principally of silicate of alumina, and vary from pure clay to strong loam. These soils are especially adapted for growing hardwoods, such as oak, ash, hornbeam, poplar, etc., and all trees that delight in a strong damp soil. On the stiffer and wetter kinds the ash does not succeed so well as the other three. When resting on a bed of sand or gravel, they suit ash and sycamore better than most soils, and the addition of calcareous matter makes a soil highly favourable to ash and spruce. A mixture of clay and gravel suits spruce, silver fir, and larch, providing the drainage is good; but, generally speaking, these soils are not suitable for growing coniferous timber, as although the trees grow rapidly when young, they are usually short-lived, and rarely produce good quality of timber, being too coarse and soft through rapid growth.

Arenaceous.—Silica forms the chief constituent of these soils, and they are usually dry and porous. Nearly all species belonging to the pine genus do well on these soils. In this country the Scots fir is the prevailing tree on them, and generally produces better timber than when grown on clay or chalk soils. Wherever the heather abounds we may generally assume that the Scots fir is the most profitable tree to plant, as such ground is usually poor and sterile, and in which few trees will thrive, but which produces a cleaner growth and more durable timber in the Scots fir than soils that are conducive to a rapid and luxuriant growth. The more fertile soils of this class suit the beech, elm, maple, and Durmast oak, but they must be of a fair depth and open nature, so as to allow the roots to penetrate freely in all directions. When moderately damp, or when resting on a clay subsoil, larch thrives well on all soils of this description, but when too dry and arid it is subject to dry rot; and the same may be said of spruce and silver fir. Pure sand is affected by drought less than any soils, but is usually too deficient in plant food to bring timber to maturity.

Calcareous.—All these soils contain a large quantity of carbonate of lime, and on the chalk formations the soil frequently consists of little else. Owing to this fact, many plants refuse to grow on soils of the latter description at all, and therefore the choice of plants is more limited for this class than for the other two. Amongst the hardwoods, beech takes the precedence in England, ash being better adapted for the north, although chalk formations are not found in the latter part of the United Kingdom, and these remarks scarcely apply to it. Many coniferous trees, the pines especially, fail to thrive on chalk, but spruce, Austrian pine, and cedar do very well. The larch also succeeds fairly well up to a certain age, but the dry rot is liable to affect it. On wet limestone soils larch should never be planted, as their close pasty nature render them totally unsuitable to that tree, and blister inevitably results.

Peat moors or bogs, properly speaking, are not soils, but as they are sometimes utilised for growing trees, they may be considered as such here. They consist entirely of vegetable matter, being the partially-decayed remains of semi-aquatic plants. Until draining has drawn off the superfluous moisture, and allowed the air to act upon and decompose the inert vegetable matter, plants, or rather trees, will not grow on them, but when this has been effected certain trees thrive fairly well. Birch, alder, willow, aspen, spruce, and Scots fir are the most suitable. When thoroughly decomposed and mixed with inorganic matter, they often form very fertile soils, suitable for the majority of trees that like a light soil.

To briefly recapitulate what has been already written on the choice of plants; the conditions of soil, climate, and altitude should be considered conjointly, and each should be considered as equally influencing the growth and ultimate success of a plantation. Although mixed plantations may be justifiable in some cases, yet a careful examination of the soil and situation, together with a knowledge of the climate, should enable a competent forester to select one, or at the most two, species as the most likely to give the best results, and thereby allow the species selected to receive the proper sylvicultural treatment it requires in order to give the best yield of timber. Certain trees which are more valuable in an early stage than those constituting the ultimate crop may, however, be planted as nurses, to be taken out in thinning, and one here and there might be left for the sake of variety. Larch and spruce are the most suitable for this purpose, the former being the most valuable in sheltered situations, the latter in exposed ones, owing to its rigid and erect growth.

Laying off the Ground.

The usual method adopted in planting a space of land is that of performing the whole of the work in one, two, or three seasons, according to the extent of the ground, state of the weather, and the number of hands employed, and with small plantations this is probably the best plan. But when several hundred acres are to be planted, a proper working plan should be drawn up and adhered to as far as possible. Instead of planting the whole of the ground in the shortest time possible, it should be divided into divisions or blocks of such sizes as to be conveniently planted, thinned, and cut in one season respectively. This system has many advantages, as, for instance, allowing the forester ample time for performing the above-named operations, giving more steady employment to workmen, and preventing a large quantity of mature timber standing in the plantation at a time when the demand for such may be limited, thereby obliging the proprietor either to sell under value or allow the trees to stand after reaching their maximum annual increment, which would result in a reduction of the returns that might otherwise be realised in a given period.

Take, for example, a plantation of a thousand acres, containing various examples of soil, and at different altitudes. To plant such an area in four or five years would necessitate the employment of a large staff of men, probably larger than the ordinary staff constantly kept by the forester. Unless a number of extra hands were specially engaged for the work, this would cause much of the ordinary winter work to be thrown back or neglected altogether, which would seriously interfere with the plans and arrangements regarding the other woods on the estate. But if the ground were laid off into squares or blocks of say 10 acres each, so many of these blocks might be planted annually without interfering seriously with other work on the estate. Assuming one hundred years to be the period required for bringing the crop to maturity, one block planted annually would provide for a similar area annually becoming ready for the axe after the first century had expired, and during the course of the second and each succeeding century, so long as the ground was replanted after being cleared. But unless the trees were all growing under the same conditions in respect to soil and situation, those on the most favourable parts of the ground would arrive at maturity much earlier than their less favoured neighbours; and in order, therefore, to prevent the necessity of cutting before ripe, or causing a break in the returns, the ground should be classified into one, two, or three classes, according to its estimated capability of producing timber, or the length of time each class would require to bring timber to maturity, and a block in each class planted in the same year. Let the ground be supposed to consist of 500 acres of Class I., capable of bringing timber to maturity in 80 years; 250 acres of Class II., requiring 120 years; and 250 acres of Class III., requiring 150 years to mature its timber. By dividing Class I. into blocks of 12·5 acres each, and Classes II. and III. into blocks of 8·3 acres each, and planting a block in each class annually, we should have a continuous crop of mature timber from the 80th to the 180th year from the time planting commenced, the latter operation extending over a period of 33 years, about 30 acres being planted annually until the work was completed. Should the ground be at all exposed, planting should commence on the leeward side of it, and gradually worked up to the windward side, as by this method the removal of those blocks which require cutting first is effected without exposing the ones immediately adjoining them to the prevailing wind, and the tops of the trees present a uniform slope to the wind, and it is therefore less likely to do damage.

The above system has the disadvantage of giving a plantation on a hill-side a patchy appearance, owing to the great difference in the sizes of the trees, but this would only be the case when the ground presented a great many variations of soil and exposure, as when planting proceeded steadily in one direction this would prevent such an appearance from being given to it.

The formation of roads at the time of planting is quite unnecessary, besides adding greatly to the compound interest on the initial expenses. They should, however, be marked off, and the ground left unplanted, or if planted, such trees should be used as are likely to be of some value when the time comes for their removal. Narrow rides about 13 feet in width should separate all blocks from their neighbours, and should be kept free of grass and rubbish, as in case of fire they may prove of great service in preventing it from spreading from one block to the other. This precaution should always be taken in the vicinity of a railway, as sparks from passing engines frequently ignite the dry grass in adjoining plantations.

Formation of Local Nurseries.

The custom of getting plants direct from a public nursery, and planting them in all sorts of soils and situations, has a great deal to do with the frequent failures and great loss of plants incurred in planting hilly and poor ground. In addition to the rough treatment they receive in uplifting and transit, and the consequent exposure of the roots, the change from a rich soil to thin, hard, and poor ground usually found on hill-sides and moorland cannot be favourable to the plants starting into a healthy growth until several years have elapsed after transplanting has been effected. The structure of roots differs a great deal according to the soil in which they exist, and it is evident that roots which have been developed in a soil of one description are ill adapted for carrying on their ordinary functions when suddenly removed to a soil of the very opposite character, and new roots must therefore be formed before the plant can extract a proper amount of nourishment from the soil. Nor does this change merely affect the roots, but the protoplasm throughout the plant has first to accommodate and adapt itself to its new and altered conditions before it regains its former activity; and until these changes have been effected the plant does little more than exist for the first year or two after removal. The ravages committed by rabbits on plants when first put out are probably due in a great measure to their unhealthy and weakened condition from the above causes. It has been frequently remarked that self-sown plants are not nearly so liable to be touched as planted ones are, and there is every reason to suppose that this is chiefly owing to the more healthy and vigorous condition of the former during the early stages, as, when once the latter have recovered from the effects of the move, they are less frequently attacked, or if they are, it is usually the weakest plants that suffer. The true explanation of this fact I have never seen nor heard, but those laws of natural economy which ensure the survival of the fittest have probably something to do with it.

The formation of local nurseries on the site of intended plantations would do away with many of the evils enumerated above, and, there is little doubt, would prove the most economical when forming extensive plantations on poor soils, as there is little difficulty in raising Scots fir, larch, and spruce on such ground. They should be formed on well-drained slopes falling gently away to the west or south-west if possible, and the soil should be of the same character as that prevailing over the ground. They should be in as sheltered situations as possible, but not likely to favour frost. They must be securely fenced against game, and the seed-beds should be protected from birds by means of wire-netting stretched over the top. The soil should be trenched as deep as possible, and, if very poor, should be enriched by the addition of leaf-mould, road-scrapings or parings, or anything of that nature. Spruce branches should be stuck round the outside of the beds when the seed is germinating, to shelter it from the wind and sun. The sowing of the seed and subsequent treatment of the plants should be the same as carried out in ordinary home or public nurseries, but being of slower growth, they might stand an additional year in the nursery lines before being planted out, and the seed should be sown rather later than usual, as larch is extremely liable to be injured by late frosts. The selection of the seed from trees standing in similar localities to that of the future plantation should be carefully attended to, and only cones off trees possessing good timber qualities and of clean growth should be gathered, as the importance of this matter to the ultimate success of the plantation is often ignored, or neglected, with unsatisfactory results.

It may be argued that a strong vigorous plant from a public nursery is more likely to survive the ordeal of transplanting than a weaker and less vigorous one, owing to the greater amount of reserve matter stored up in the stem of the former than in the latter, and this is, no doubt, perfectly true when both plants have been growing under the same conditions, and are subjected to the same treatment before being finally planted out; but when the stronger plant has several great disadvantages to contend with which are not shared by the weaker, the positions of the two plants may be considered as reversed. It must also be remembered that the embryo growths in the buds of the stronger plant require a proportionally larger amount of nourishment to develop them, and therefore the apparent advantage in regard to reserve material is less than might appear. It must be admitted, then, that plants raised on the ground have the advantage so far as transplanting is concerned, and the additional trouble and expense of forming a nursery is fully compensated for before the planting of a large area is completed.

Size of Plants.

The size of the plants at the time of planting must depend a good deal upon the nature and situation of the ground. For exposed and elevated situations, one-year seedling, one year transplanted, are probably the best, as they have a better chance of getting established in the ground. In more sheltered positions, and where the herbage is coarse and rank, two-year seedling, two years transplanted, may be used, and in ordinary situations no advantage is gained by planting them larger than the latter size. The former size refers only to conifers, the latter to both conifers and hardwoods. The great desideratum is to obtain plants with their roots and tops equally proportioned, or if one of the two preponderate, let it be the former.

Distance between the Plants.

The distance apart at which the trees are to stand after the final thinning should determine the distance apart at which to plant. To fully utilise the ground, and give the plantation a regular and uniform appearance, the special requirements of each species used (or more properly of the species to form the ultimate crop) in regard to space should be carefully considered. The probable rate of growth and capabilities of the ground will have to be considered, but the principal thing requisite is a knowledge of the maximum number of trees which a given acre of ground is capable of growing and bringing to maturity. By dividing the area by this number, the space occupied by each tree is obtained; and the square root of this area, divided by a power of two, corresponding to the number of regular thinnings intended, gives the distance which should separate the young plants. This may be considered unnecessary and too theoretical, in view of the many accidents and casualties which may occur during the lifetime of a plantation, while no allowance is made for the greater demands of strong and vigorous trees for space compared with their weaker neighbours. The first objection has no more weight than the case of a man who objected to being educated when young, for fear of dying before he could make use of it; and the second would only apply to mixed plantations, which are not alluded to here.

The average distances apart at which the following trees are usually planted, are—Scots fir, $2\frac{1}{2}$ to 3 feet; larch 3 to 4 feet; spruce 2 to 4 feet. Hardwoods are usually planted at good distances apart, about four times the number required for the ultimate crop say, and the intervals filled up with coniferous nurses, to 3 or 4 feet apart. The following distances are suitable for—oak, 8 feet; ash, 9 feet; elm, 12 feet; beech and hornbeam, 6 feet apart, respectively, the distance for oak being one-eighth of that of the ultimate crop. Mixed plantations are usually planted about 3 feet to 4 feet apart.

Planting.

Planting may be performed at any time during the natural suspension of growth, which, in this country, means from November to April inclusive. The spring months are preferred by many foresters for planting, especially where the ground is at all wet, as the roots commence to grow before they have time to lose the vitality of the fibrils, which frequently takes place in wet soils when the roots have been bruised or broken in lifting. On dry, sandy soils, autumn planting usually gives the best results, as they are firmly established in the soil before the drought of summer commences, and the notches are not so likely to open and loosen the plant as when planting is done in the spring. Planting should only proceed in fresh, open weather, and never during frost or snow.

For small plants notching is the cheapest and most expeditious method of planting, and for this the planter should be provided with a sharp half-worn garden spade. Inserting his spade perpendicularly into the soil, he makes two cuts or notches at right angles to each other, shaped like the letter L. He then lifts up the corner of the notch so as to allow the roots of the plant to be inserted beneath the spade, which is then withdrawn, and the soil falls back into its place, covering the roots, and is made firm with the heel. The planters should work in extended lines, each man taking his distance from his right or left hand neighbour, according to the side the leading man is on. Every two men should be accompanied by a boy or woman to carry the plants and insert them in the notch, the planter seeing that the roots are not twisted or doubled up before he withdraws his spade. The boys and women should be provided with aprons with large pockets for carrying the plants, the latter being supplied to them by others specially told off to carry the plants from the "sheugh" to the planters, so as to prevent the roots from long exposure to the sun and wind.

In pit-planting much the same method is adopted as the foregoing, except that instead of making a notch, a small hole is taken out about a foot square; the boy holds the plant in the centre, while the planter fills in the finer soil immediately round the roots, leaving the worst for the top. In damp soils pitted plants are apt to be thrown out by the frost if planted in autumn, and are therefore best left until the spring. When planting hardwoods with coniferous nurses, they are often planted at their proper distances before or after the nurses, which simplifies matters for the planters and prevents mistakes. In all planting operations careful work should be encouraged before speed, and in very rough and stony ground it is better to take out a hole and remove the stones, than to squeeze and crush the roots into places where there is nothing to support them.

Sowing in situ.

The practice of sowing *in situ*, or sowing the seed on the spot in which it is intended to grow, is rarely resorted to in this country, and it has many disadvantages, compared with planting, on rough or waste ground. It might, however, be adopted in afforesting old arable land with hardwoods, such as oak or chestnut. The hardwood seed should be sown in lines about 8 feet apart, or double that distance, if the ground is suitable for growing larch to a fair size, and the latter tree substituted between the hardwoods, as it is more valuable when young. Two or three seeds should be sown or dibbled into each spot intended for the site of a tree, which should stand about 8 feet apart in the lines, thus allowing for contingencies in the shape of bad germination, damages by vermin, deformed plants, &c. If the ground be fairly clean, the intervening spaces might be sown thinly with larch seed, but if dirty, it would stand in great danger of being smothered before it attained any size, and planting would be preferable, the plants being put in about 3 feet apart. Spruce and Scots fir might also be used if the ground were unsuitable for larch, but the latter tree being double the value of the former two, should always be used if possible. Other hardwoods than the two mentioned might be raised in this way, but owing to their strength and vigour as seedlings, oak and Spanish chestnut are better adapted for it than any others.

When the ground is in good condition, and the heather short, good results might be obtained by sowing Scots fir broadcast on heathy moors and hill-sides, as the regularity with which this tree comes up on such ground where self-sown, produces almost as good and perfect a crop as could be secured by planting. It is only on heath-covered ground, however, that this would be likely to succeed, as grass or any other herbage is too thick and close to allow the seed to obtain a good hold of the soil. Of course, a large percentage of the seed would be lost, and therefore this system could only be recommended when seed is cheap and easily obtained, but many barren acres of hill-side and moorland might be afforested by this method at a considerably less cost than planting.

Protection from Ground Game.

Where ground game abounds, it is necessary to protect the young plants by means of wire-netting. This should be supported by short posts, about 4 feet long, driven firmly into the ground every 6 or 8 feet, or the netting may be attached to a wire fence when it surrounds the ground requiring protection. A small trench about 3 inches deep and wide should be taken out, and the bottom of the netting placed in it, about 3 inches at the bottom being laid flat, and the soil replaced. This prevents rabbits from scratching holes underneath it, which they quickly do when it merely touches the surface of the ground. All holes should be ferreted and stopped after the netting is up, otherwise some may be left inside. To protect any large area from rabbits by means of netting is practically impossible, the only effective remedy being that of keeping them down by shooting and trapping, and allowing their natural enemies, such as stoats, weasels, foxes, &c., to restore the balance of nature. The settling of this question, however, is usually outside the forester's jurisdiction, and he must do what he can, and leave the rest to take its chance.

Management for First Twelve Years.

The principal work to be done during the first two or three years after planting will be beating up blanks and keeping down rubbish.

If a fair proportion of the trees survive, the former operation is often neglected on the grounds of economy, and rendering a profitless thinning unnecessary. When the production of large trees is alone aimed at, such an omission may be commendable, but when a crop of clean-grown timber of good quality is desired, it has several objections. In the first place, it favours the growth of coarse side branches wherever gaps exist, which often attain considerable size before they are overpowered and killed by the closing up of the leaf canopy, causing black knots in the timber. Secondly, the stems are exposed to the sun, and unequal zones of soft and sappy wood are formed early in the season. Thirdly, the complete subjection of the herbage is considerably retarded, and the roots of the trees are deprived of a good deal of the available food. Fourthly, the mechanical condition of the soil produced by close shade, and a covering of decaying leaves, which is so eminently favourable to the production of roots, is not attained until the trees are in close order, and is therefore longer in taking place when gaps are numerous. The above objections more than counterbalance any advantage to be gained by the omission of beating up, and therefore it should be attended to wherever practicable.

The subjection of rubbish depends a good deal upon its nature. Whins and broom must be carefully watched and kept from closing over and smothering the plants, and if they are cut over with a hand or hedge bill every two years until the plants are well above them, there is little danger of this taking place. Grass rarely does much harm, except to very young plants, which should never be planted amongst it. Brackens, brambles, &c., will require annual attention for a year or two, but the work should never be entrusted to careless or irresponsible hands, or more harm is likely to be done than good.

After the plants are fairly established in the soil, they will require little attention until the eighth or tenth year, according to the rate of growth, but hardwoods should be gone over, and all double leaders removed. Oaks often refuse to start freely into growth after being transplanted, and when this is the case they should be cut over close to the ground, and allowed to break away from the bottom, all but the strongest shoot being removed after a year or two.

About the tenth year after planting, the first regular thinning is usually performed. This is generally done by cutting out every other plant, and leaving them about double the former distance apart, the nurses only being removed in the case of hardwoods. No doubt this method provides for the welfare of individual trees better than any other; but sylviculture recognises the claims of a mass or number of trees collectively, rather than the special requirements of the units which compose the mass, and aims at growing *timber* and not merely *trees*, and therefore we might consider whether the usual method of thinning is the best to attain the object in view. In all natural forests it is evident that the operation of thinning by means of the axe and saw has never been carried out, and yet it is from such forests that our best timber supplies have been drawn, and an endeavour will be made to show the reason of this fact. Let us take the case of a piece of heath-covered ground that is being self-sown by Scots fir. Here we find the plants that show themselves first scattered here and there over the ground, some of them separated from each other by 20 or 30 feet. Every successive year a few additional plants appear, gradually filling up the blank spaces, until the whole surface of the ground is eventually covered with plants. By this time, however, the first plants that appeared will be considerably in advance of their youngest neighbours, and will have acquired a certain amount of superiority over the others, according to their age and vigour. It is evident that if nothing occurs to stop the growth of these larger plants, they will be in no danger of being overtopped or smothered by their neighbours, but will continue growing until they have reached their full height. But although they may have free space for upward growth, they may be checked or stopped altogether from developing their lateral branches by smaller but equally vigorous plants that are growing up around them. Suppose a large plant to be 6 or 8 feet in height at the time a smaller plant, standing 6 feet away, is only 3. Assuming the lowest branch on the former tree to extend 3 feet in the direction of the latter, it would allow a space of nearly 3 feet between the nearest branches of the two trees, assuming the branch in question to be the longest on the side of the tree. This space would gradually decrease until the branches of the two trees touched, when their growths would be checked and ultimately stopped, causing their death. Other branches, higher up on the stems of the two plants, would, however, be meeting in the same way and sharing the same fate, always leaving, however, a clear space between the leading shoot of the smaller plant and the nearest branch opposite on the larger. Supposing the two plants to keep their relative positions, and make uniformly equal growths until both had reached their full height, a system of natural pruning would have been carried out on the sides of both stems that faced each other, the branches on the smaller plant being checked and killed earlier in life than those on the larger one however. If small plants had stood on every side of the large one, the pruning process would have been complete, and we should have a typical illustration of what takes place, more or less, in a natural forest, and which produces pine timber of such excellent quality and almost free from large knots.

It is not contended, however, that such a method is the best and most economical for the practical forester to adopt in the case of plantations, and there are several reasons for coming to this conclusion. In the first place, the trees in a plantation are nearly equal in size, and would, therefore, be in danger of sacrificing one another before one could rise above the other. In the case of the natural forest, too, only one out of every ten may be placed in the way we illustrated, and therefore the proportion of well-grown timber trees will be comparatively small, and not sufficient to give a fair yield. But in spite of these objections, it is evident that the same principles will hold good in the case of artificial plantations, as in the natural forests, although the treatment must be modified to suit the altered conditions.

Even in artificial plantations, however, by the time the trees require thinning, they will not be found all one size. Some will be found 2 or 3 feet taller than others; or, in other words, natural selection will be operating on the crop. The duty of the forester, then, will be to assist this operation as much as possible, and endeavour to secure a regular distribution of strong, clean-growing trees, by checking the tops of all trees that are competing too closely with those that are intended to grow until the second thinning. By the ordinary method, the unnecessary (?) trees would be taken out altogether, but the objections to this method are these:—In the *first* place, it exposes the soil to the sun and wind, and it becomes hard and dry and unfavourable to any roots that may have found their way along the surface; *Second*, grass and rubbish again begin to grow, and appropriate the moisture and humus; *Third*, the stems of the plants are exposed to the sun, and the development of side branches encouraged, causing the formation of inferior wood. Other objections might be raised, but these are the principal ones, and are thought to be sufficient to justify the adoption of the above method, recommended generally, although cases may occur where it might not be practicable.

Conclusion.

To go fully into every subject bearing on the formation of plantations, would require more space and time than could be expended on an ordinary essay, and therefore many subjects and operations are only briefly described and treated upon; but as their general application has been kept more closely in view, than their particular adoption or execution in any one locality, no advantage would have been gained by going too closely into details.

Some of the theories propounded in this essay are based upon observation rather than experience, and therefore difficulties may be in the way which might render their practical adoption impossible; but as custom without reason has been defined as an ancient error, the risk of committing a modern error has been incurred, rather than the recommendation of any customary operation for which no logical reason could be given.

VIII. *Trees and Shrubs for Planting in Towns.* By A. D. WEBSTER, Holwood, Kent.

To those whose lot is cast in or near our more important centres of industry, this subject is of vast importance, and one which, at the present time, occupies a large share of public attention.

The surprise experienced by most persons in this country on first visiting any of the larger Continental cities—Paris, Brussels, or Berlin, and where street planting would seem to be considered as a matter of paramount importance—is great indeed, and invariably leads to the somewhat pertinent question, "Why cannot we make our cities beautiful by planting suitable trees and shrubs?" No doubt there are a few drawbacks to be encountered in so doing, but that very much more might be accomplished than has hitherto been done is clearly evident to those who have devoted even a small share of attention to the matter.

The atmosphere of our larger towns and cities—London, Glasgow, Liverpool, Manchester, and Sheffield—is, it must be candidly admitted, impregnated to a far greater extent with noxious fumes and vapours than is that of any of the Continental towns above mentioned, and, therefore, the difficulty of establishing many trees and shrubs is correspondingly increased.

Observations and experiments carried on during the last ten years in three of the largest towns in Britain—London, Glasgow, and Liverpool (a trial garden was for this express purpose instituted in one of the most smoky districts of East London)—have clearly proved, however, that there are not a few trees and shrubs well suited for withstanding even the deleterious effects of the impurest of town atmospheres.

Not for one moment do I wish it to be inferred that there are not certain districts—to wit, the environs of the Lambeth potteries, and some of our huge chemical works—where, do what we will, vegetation, be it of whatever kind, will not succeed; but as we recede from these centres of sickness and death, particular trees and shrubs flourish amazingly, and no better example can be pointed out than the healthy and rapid-growing specimens that adorn the Thames Embankment, and which are removed but a very short distance indeed from one of the barrenest and most miserable of the city suburbs—the pottery district.

That certain trees and shrubs succeed best in particular towns is another strange fact, for, curious as it may seem, the smoke-proof London plane is by no means the best tree for either Liverpool or Warrington, particularly the former town, where the sycamore has been found to be far better adapted. In the very centre of Sheffield the Canadian poplar has been found to be by far the most useful tree, while in some of the worst localities in the colliery districts the chestnut and variegated-leaved sycamore are the greatest favourites. Even the rhododendron does well in the most smoky parts of the town of Bury, Lancashire. No better example could be adduced of how certain trees favour certain towns, than two or three kinds of poplars which grow with unabated vigour at Gatley, a small town near Manchester; while at Bury, about equally distant on the other side of that city, they positively refuse to grow, and that too after many unsuccessful attempts to get them established. Neither the rhododendron nor the laurel are at all suitable for the smoky districts of London; but casual observers may form a different opinion, from the appearance of such of these shrubs as are replanted annually, the semi-sickly subjects being replaced at stated times by those that are fresh and vigorous. In the smoky and impure (chemically) atmosphere of Glasgow the thorn and beam tree (*Pyrus*), as also several kinds of *Retinospora*, thrive amazingly, much better than they do in any of the large English towns.

Why certain trees and shrubs succeed best in particular districts or towns is, perhaps, readily enough explained by the conditions of soil and situation, as well as the particular industry of the inhabitants. Coal smoke from the multitudinous chimneys of our larger centres of industry is no doubt bad enough; but when we have to contend with an atmosphere largely impregnated with the outcome from chemical, gas, or iron works, the difficulties to be encountered are great indeed.

Preparation of the Ground and Planting.—In order that success may crown the effort, it may truly be said that no work of the horticulturist requires more skill and good management than the proper planting of trees alongside streets and avenues.

The materials with which roads are usually made up are ill-fitted for sustaining a healthy condition in trees, at least for any great length of time, and this is well known to those who have taken any interest in the matter—broken stones, clinkers, and gravel affording but small support to vegetation, be it of whatever kind, but particularly large-growing trees and shrubs. Many failures in street tree planting from this very cause might be pointed out, and in not a few cases the future result will certainly be discreditable to all concerned, simply because the work has not been properly done.

In crowded streets and squares, where the air is vitiated with impurities, and the soil hard and often surcharged with gaseous matter, tree planting is quite a different matter to what it is along the side of a field. In the latter case it may be sufficient to open a small pit, insert the tree, and stake it; but in our large towns the case is totally different, for the soil, hard as iron, and composed mainly of clinkers and shingle, affords but little nourishment to a rapid-growing tree, and one that, moreover, has to do battle above ground with the deleterious effects of an impure atmosphere. Another fruitful cause of failure in street planting is placing the pavement above the roots, and in too close proximity to the stems. The roots should always be allowed plenty of breathing room, and to effect this a good-sized space should be railed off around each tree, and no pavement laid within it. In so doing a double benefit is conferred, by allowing free access of rain to the roots, and avoiding the accumulation of noxious gases in the ground (as has been proved to be the case when close pavement has been used), which are inimical to the welfare of the trees.

In proof of what is said, we may refer to the trees at the Chelsea end of the Thames Embankment, which have been planted as above directed; and that success has amply crowned the effort cannot be denied, for certainly that noble avenue has no equal in any British town.

Where street trees are to be planted, a good-sized patch of ground —say, at least 6 feet in diameter and 4 feet in depth—should be thoroughly broken up, and if the soil is of inferior quality, which will assuredly be so in 90 per cent. of the pits, good fresh loam should be substituted. By undermining the sides of the pits a much larger receptacle for the fresh soil will be formed, and this will not occasion so much of the footway and pavement being torn up as if the pits were of equal diameter top and bottom. The plants used should be such as have been specially prepared for the purpose, by being frequently transplanted for some years previous to being placed in their final position. They should be stout, stocky, well-rooted, clean, and from 6 to 8 feet in height.

In planting, spread the roots well out around the stem, and do not bury too deeply, the mark visible on the stem as to how deep the trees stood in the nursery border being the best criterion to go by. As regards the best time to plant town trees opinions differ, but there can be little doubt that spring is preferable, for the good reason that, as they start into growth at once, they are not so likely to suffer from smoke and other deleterious affections as if they remained during the winter in an inactive condition.

Staking the trees so as to prevent rocking by the wind, and consequent damage to the roots, should be set about immediately planting is finished. Circumstances will be the best guide as to how this should be done, but it is generally found necessary, even when the trees are surrounded with iron railings, to drive a stout stake firmly into the ground on the windward side, and as close to the stem of the tree as possible. To this the tree should be made fast with teased-out tarred rope, and to avoid friction the rope may be crossed between the stem and stake.

These simple matters connected with the preparation of the ground, planting, and staking are so important in town planting that they should never be lost sight of, for while they add but little to the cost, the advantage gained is very great.

Advantages of Town Trees.—Not only for the cheerful aspect produced by trees when planted alongside streets and thoroughfares, but also from a sanitary point of view, they are of special value and the greatest importance. That a quantity of healthy-growing foliage has a wonderful effect in purifying the atmosphere is a recognised fact, and certainly far more than compensates for any damage to health that might be occasioned by its decay in autumn. Bearing on the question of trees in towns, Dr Phené, at the Social Science Congress at Edinburgh, remarked as follows:—

"To the occupants of houses in streets having a northern aspect, the glare of reflected light is injurious; but the effect would be much modified by the coolness to the eye produced by the green of trees. In ancient surgery, persons having weak or declining sight were advised to look at the emerald. In the old style of building, the streets being narrow, were both cooler, from the sun not being able to penetrate them with direct rays, and less subject to noxious exhalations from the scouring and purifying effects of the searching air to which narrow streets were subject, so that while there was no space for trees, there was also less necessity. Wide streets, on the contrary, are hotter, and require the shade of trees to cool them, and, as in the case of London, which has so far done without trees in its streets, not only are modern streets compulsory wide, but the enormous increase in metropolitan buildings renders every sanitary question one of importance; and the chemical properties of trees, as shown by experiment, gives them an important standing on that ground, irrespective of ornament or the pleasure they produce. But that which is important in such localities is more imperatively demanded in poorer districts on the score of health, as during the last year alone 21,000 new houses were erected in London, producing 400 streets, with 71 miles and 468 yards of promenade."

Trees.

The Oriental or Common London Plane (*Platanus orientalis acerifolia*).—This variety of the Oriental plane stands first in the category of select town trees. Not only does it grow vigorously in towns, but it is peculiarly well adapted for withstanding the smoke and other impurities of their atmosphere. Repeated experiments have clearly proved that in London this tree flourishes better than any other, and a visit to the Thames Embankment, and several other of the urban districts, will substantiate the statement; while the fine old tree which still exists at Cheapside, and the equally beautiful specimen, which has hardly room for perfect development, in the Court of Stationers' Hall, Ludgate Hill, afford other examples of how well suited this handsome tree is for doing battle with the smoke and impurities of the great metropolis. As a diversity of opinion has existed about which variety of plane it is that grows with such vigour in and around London, it may be stated that, on a careful examination of a large number of specimens, the variety *P. o. acerifolia* was found not only more commonly distributed, but likewise better suited for town planting than the typical *P. orientalis.* This valuable variety is readily distinguished from the normal plant by the less deeply divided leaves; and from the American plane (*P. occidentalis*), with which it is not infrequently confounded, by the many fruit "balls" which are attached to each peduncle, the fertile catkins of *P. occidentalis* being for the greater part produced singly.

But not only for its value as a town tree is the Oriental plane much sought after; for the giant proportions to which it attains, coupled with the handsome, finely cut leaves and easy habit of growth, renders it one of our most desirable ornamental trees. Then it is of the easiest culture, succeeding extremely well in soils of the very opposite qualities. Taking everything into consideration, we question much whether any other of our forest trees is of greater or even equal value with the plane for town planting.

The Maidenhair Tree (*Ginkgo biloba*).—A prolonged visit to the very worst smoke-infested slums of London, has now quite convinced me that the maidenhair or ginkgo tree is one of the most valuable that can be planted in the impure atmosphere of a town garden. Few trees, I am fully aware, can compare with the one in question for withstanding the deleterious effects produced on vegetation generally by coming in too close contact with the impurities of our great centres of industry. The ample delicate green foliage betrays—even late in the season, and when about to be cast off—little evidence of the fierce struggle that must almost constantly go on between vegetation and the smoke and filth of our towns and cities. That the thick leathery leaves and strong constitution of the tree play an important part in keeping it free from disease is clearly evident, while the fact of the leaves being renewed annually must go a long way towards casting off the sooty nodules which work such havoc on the tender foliage of most trees.

At no less than five places in and around the great metropolis—and such places, too, where one is almost stifled with the fumes from chimneys—the maidenhair tree may be seen almost in as fresh and flourishing a condition as those enviable specimens on the Isle of Man ; indeed, about as large trunks as can be seen anywhere are growing in the smoke of Chelsea. Not only as a standard tree is the maidenhair valuable, but it is also one of the prettiest wall plants with which I am acquainted, and how many bare ugly erections of brick and stone in our city streets want a bit of greenery I would not like to say.

The Ailanthus, or Tree of Heaven (*Ailanthus glandulosa*), may be seen in a flourishing condition in many of the London streets and byeways. By its rich green spreading foliage, the Ailanthus is, during the summer months, a great favourite with lovers of sylvan scenery, the leaves in many cases reaching to a length of fully 2 feet. It is a tree of very rapid growth when suitably placed as regards soil and situation, shoots nearly 2 feet being often produced in a season.

It has been largely planted in many Continental cities, and has proved itself one of the few trees that are capable of withstanding the impurities of a town atmosphere. The greenish-white, inconspicuous flowers, are freely produced, and are succeeded by innumerable fruits resembling the keys of the ash, but of a reddish-brown colour, which imparts to the tree a wealth of autumn glory that we unfortunately are seldom permitted to witness in this country.

The Black Italian Poplar (*Populus monilifera*).—Next to the plane amongst forest trees, I consider the black Italian poplar to be the most valuable for planting in smoky towns. As a proof of this, there are to be seen numerous fine specimens of this tree in a flourishing condition, and clothed with the most healthy foliage, in some of our largest cities—to wit, London, Glasgow, and Liverpool. The black Italian poplar may be somewhat stiff in outline, but there is, nevertheless, an air of grace about it that is wanting in any other tree I can bring to mind. It is a tree of the readiest culture, while, as to its rate of growth, a specimen of 100 feet in height has attained to that size in less than sixty years. The wood, unless for a few special purposes, such as cart-bottoms, brakes, &c., is not of great value; but the tree is, nevertheless, a profitable timber-producer when grown in suitable soils.

The Canadian Poplar (*P. canadensis*) and its variety, *P. c. nova*, are excellent trees for planting in smoky localities. The former succeeds admirably in the very centre of Sheffield, in the old parish churchyard, where for hundreds of yards away not a particle of living vegetation is to be seen. The variety *nova* is a very superior tree for street planting, it being far more ornamental and of more rapid growth than the black Italian poplar, and equally reliable for retaining a healthy and flourishing condition under the adverse circumstances connected with a town atmosphere. How well it succeeds may be seen in the beautiful avenue that was formed of it and the Oriental plane some years ago at Wimbledon Park.

The Abele Poplar (*Populus alba*) grows with great freedom where subjected to smoke and foul air. In the very heart of our largest towns, it may be seen flourishing in a manner that is almost incredible. It is a pretty tree, the distinctly cut, ample leaves, with their cottony under surface, being at all times, but especially when agitated by the wind, most interesting, and causing the tree to rank amongst the most ornamental of its kind. It is readily propagated, transplants freely, grows rapidly, and is neither subject to disease nor particular as to the soil in which it is planted.

The Lombardy Poplar (*P. fastigiata*) is another tree that has been planted with some success in and around many of our largest cities, but it cannot equal any of the foregoing for withstanding the baneful effects of a tainted atmosphere. In the outskirts of towns, where the air is purer than amid chimneys pouring forth their volumes of smoke, the Lombardy poplar succeeds fairly well, and imparts an air of grandeur that could hardly otherwise be obtained.

The Cucumber Tree (*Magnolia acuminata*).—Few planters are aware of how valuable the cucumber tree is for withstanding the grime and soot of large towns. Experiments have, however, resulted in this highly-ornamental and fast-growing tree being added to the list. Its ample foliage, yellowish-white fragrant flowers, and general contour, eminently fit it for a first place as a town tree. Soil of ordinary quality suits its general wants, although it prefers a strong, yellowish moist loam.

The Tulip Tree (*Liriodendron tulipifera*).—Excellent examples are not wanting of how valuable a tree *Liriodendron tulipifera* is for towns and streets. It seems to have a wonderful recuperative nature, for scorched, blackened, and encrusted as may appear the falling-off foliage, yet in the following spring it again puts forth a garb of the freshest and richest greenery. The remarkable four-lobed, truncate leaves render this tree almost without an equal for ornamental planting, while its undoubted smoke-resisting qualities place it high in the rank of town trees. It is not particular as to soil.

The Indian Bean (*Catalpa bignonioides*).—For various reasons this fast-growing tree is to be recommended for planting in smoky localities. It grows with vigour in many smoky centres of industry, is a tree of handsome proportions, and when fully established, flowers freely. The violet-white of the petals of the flowers is well set off by the purple and yellow of the throat. A valuable trait in the character of the Indian bean is that, should accident befall it, and the stem get injured, numerous strong suckers are produced, which, as they grow with great rapidity, soon take the place of the original. Few soils come amiss to it.

The common Mulberry (*Morus nigra*) and the white-fruited form (*M. alba*) may be seen growing satisfactorily in several of the old gardens and nurseries of the metropolis, and where they are now buried alive, as might be said, in stones and mortar. That they are excellent town trees will be admitted by everyone who sees the fine specimens in Liverpool and Manchester.

The Honey Locust (*Gleditschia triacanthos*) is a tall, spreading tree, one of great beauty, and a very suitable subject for planting in smoky localities. In many of the worst smoke-infested parts of

London and Manchester are seen goodly specimens of this handsome tree—not poor, miserable trees, but from their great size, wealth of foliage, and general appearance, betoken perfect health amid their rather adverse surroundings. It grows very freely even when rather carelessly planted, and in soil of inferior quality. In autumn the long fruit-pods give to the honey locust a distinct and curious appearance.

The False Acacia (*Robinia Pseud-acacia*).—Almost by the hundred can the false acacia be seen in London and many other English towns, thus proving that it is one of the most valuable trees that we possess for withstanding the injurious effects of an impure atmosphere. It is, likewise, one of the most ornamental of trees, the great wealth of pure white flowers, and beautiful pea-green foliage, being of the richest description.

What renders this acacia of greatest value as a town tree is that it retains its rich verdure till well on in autumn. It grows freely in almost any soil, reproducing itself freely in suitable positions, and soon forms a handsome tree of almost giant proportions. The most suitable for town planting are the upright-growing and free-flowering kinds. The varieties known as *Decaisneana*, *microphylla*, *macrophylla*, *sophoræfolia*, and the upright-habited are most to be desired.

The White Beam Tree (*Pyrus aria*).—In many of the confined spaces in Glasgow, the white beam tree grows luxuriantly, and produces annually great quantities of its brightly-coloured berries. The creamy white of the under side of the leaves is particularly attractive when agitated by the wind, and the wealth of small white flowers is a treat to behold. Few trees are more readily suited with soil, for it may be found in a state of nature growing on dry limestone rocks, where there is scarcely a particle of soil.

The Lime (*Tilia Europæa*).—Where the situation is not too confined, and where soot and smoke do not abound, the lime may and does succeed; but when used in the worst parts of the metropolis, it soon shows signs of distress, the tips of the branches dying off, and the whole tree sooner or later showing the fierce struggle it has to endure with smoke and fumes. As an avenue tree, in the more airy and pure parts of a town, the lime has certainly few equals, its general contour and the pleasing shade it affords being points of special recommendation.

The Sycamore (*Acer Pseudo-platanus*).—This tree may be classed as amongst the most useful for planting in smoky towns. In

Warrington, where the noxious emanations from alkali and other chemical works are most disastrous in their effect on trees and shrubs, the sycamore is one of the few that grow satisfactorily. Being a rapid and strong grower, it is thus seen to be, for a certain time at least, unaffected by its inimical surroundings. The variegated variety would seem from recent experiments to be preferable and better adapted for smoky localities than the normal form.

The Weeping Ash (*Fraxinus excelsior pendula*) would seem to be superior to the common ash for planting in towns. It thrives satisfactorily in many of our largest centres of industry—to wit, London, Liverpool, Glasgow, and Manchester. Being of slow growth and dwarf in size, it is well suited for planting where space is confined. It is of the easiest culture.

The Horse Chestnut (*Æsculus Hippocastanum*) and the English Elm (*Ulmus campestre*) may be seen in a fairly satisfactory way in many town parks, but only where they are not exposed to smoke and soot to any great extent. In confined spaces both these trees soon show signs of distress, the points of the branches gradually becoming unhealthy, and the trees ultimately dying off prematurely. Taking everything into consideration, neither of these trees can be recommended for planting in smoky districts.

The Birch, Walnut, Hornbeam, and one or two kinds of Willow will succeed in the less smoky parts of a town; but they are not to be recommended for planting where the air is constantly impregnated with soot and dust.

The Mountain Ash, or Rowan Tree (*Pyrus aucuparia*), has proved itself to be a valuable small-growing tree for planting in urban districts. It is also a tree of great beauty, whether in flower or fruit, one that grows almost anywhere, and with a minimum of attention. In many town streets where the air is vitiated with fumes, the mountain ash grows with great freedom.

The Alder (*Alnus cordifolia*).—In this we have a good addition to the few trees that are really suitable for town planting, for it grows with great vigour, and retains much of its fresh, spring-tide greenness in very smoky and impure localities. Of hardy constitution, and unusually strong growth, it seems to defy the sooty emanations from hundreds of chimneys in two at least of our largest centres of industry.

The Bird Cherry (*Cerasus Padus*) may be classed among the most valuable of our town trees. It is a robust-growing and bright-flowering small tree. Few soils come amiss to it, and even where it is hemmed in by taller-growing trees, and constantly subjected to their drip, it grows and blooms with the greatest of freedom. In many of the back streets and slums of London may be seen well-grown specimens, which clearly demonstrate how well suited it is for withstanding smoke and dust.

The Sugar Maple (*Acer saccharinum*) is a handsome, hardy, and fast-growing tree of moderate dimensions, and one that can justly claim a place in any list of town trees. It will not succeed where constantly subjected to smoke and fumes, but planted in the suburban districts it soon forms a really handsome and distinct tree.

Sophora japonica is worthy of recommendation as a tree that is admirably suited for planting in towns. It is of large and rapid growth, with elegant dark green pinnate leaves. Being a native of China and Japan, it may not be perfectly hardy in the colder portions of the British Isles, but it succeeds well in southern England and Ireland, and it thrives admirably in the most smoke-infested parts of London.

Thorns of various kinds succeed in town parks and gardens, but they are not to be recommended for the most smoky and confined localities. In Glasgow, however, I have noticed how well suited for planting in the squares and public gardens many forms of the thorn are; indeed, even in London, and where smoke and dust are by no means wanting, they gladden the eye with their wealth of flowers and bright green leaves. The single and double scarlet would seem to be best adapted for withstanding soot and smoke; and these may not unfrequently be seen of large size and in perfect health.

The Tansy-leaved Thorn (*Cratægus tanacetifolia*) is another excellent member of the family for town planting. A noble example may be seen near the entrance to the Glasgow Botanic Garden.

The English Yew (*Taxus baccata*) can hardly be recommended as a suitable tree for smoky localities, although in suburban districts it grows freely, and there forms a dense, healthy dark green mass. From this it must not, however, be inferred that the yew cannot survive in smoky towns, for it grows freely wherever it is not subjected to an inordinate amount of atmospheric impurities. Soil of fairly good quality should be used when planting the yew, particularly where the surroundings are unfavourable.

Hollies of various kinds are very suitable for planting in cities, but they are not to be recommended for using in densely populated districts. For a time they may and do succeed, but they ultimately begin to show signs of distress by the tips of the branches dying off bit by bit. The dwarf variety of the common holly is one of the best for smoky districts, where it grows freely, and looks bright and healthy, often in most objectionable quarters. It succeeds much better than any of the others in the London squares and parks, while it is valuable in the more confined parts of Liverpool and Manchester. In Glasgow and Edinburgh it also grows freely.

Two other species at least do well where they are not subjected to an inordinate amount of smoke. These are *I. Balearica* and *I. Hodginsii*, two very distinct and desirable hollies.

SHRUBS.

Of these there is rather a long list of kinds that are suitable for planting in smoky localities. Evidently deciduous species possess an advantage over evergreen kinds in the total annual renewal of their leaves; and hence it follows that, as with trees, deciduous shrubs should have the preference.

The following list includes only such kinds as have been proved suitable for town planting:—

Osmanthus ilicifolius is one of the handsomest of evergreen shrubs, and also one of the few that succeed in a satisfactory way when subjected to the impurities of a town atmosphere. In the smokiest districts of both London and Liverpool, it is unquestionably the best all-round shrub. The holly-like leaves are thick and of firm substance, and the inconspicuous yellowish-green flowers are also much like those of the holly.

Ligustrum coriaceum is a fitting companion to the last, so far at least as its powers of withstanding the effects of an impure atmosphere are concerned. Being an evergreen, it is peculiarly well suited for planting in the town garden, where it grows with great freedom. It is easily managed, not particular as regards soil, is readily increased, and bears trimming in with perfect impunity.

Aucuba japonica.—This well-known evergreen shrub is of great value for planting in urban districts, it being able to do battle with a more than ordinary amount of atmospheric impurities. For this reason it has been largely planted in town squares and gardens in the most crowded and densely populated parts. As an ornamental shrub, too, the *Aucuba* is well worthy of extensive culture, its fine, large, glossy, and beautifully mottled leaves being at all times objects of admiration. It is easily raised from cuttings, and grows with great freedom in any soil.

Griselinia littoralis.—Although a little-known evergreen, this is well suited for town planting, experiments having proved it a most valuable addition to the limited number of shrubs suitable for such a purpose. The appearance of the plant, with its deep, green, glossy, and somewhat succulent leaves, is most pleasing; and as it grows freely in ordinary soil, and is readily propagated, it is to be hoped that it will receive the notice it is fairly entitled to as a valuable hardy shrub.

Hibiscus syriacus.—This is one of our most valuable late autumn-flowering shrubs, and is also one of the few that can successfully battle with an impure atmosphere. In many parts of London, where the air is vitiated by emanations from factory chimneys, this pretty shrub is seen in perfect health, with plenty of foliage of the richest description, and quite a wealth of showy flowers. It grows freely in ordinary soil. It may be trimmed in at pleasure, and withstands frost perfectly. It is a shrub which town residents should plant freely, if they have a bit of ground that they want to look pretty.

The Wayfaring Tree (*Viburnum Lantana*).—This valuable shrub does not receive that amount of attention which its merits entitle it to. It succeeds well in some of the most filthy and smoky districts of our largest cities. It blooms with great freedom, and the flowers are succeeded by the brightest and showiest of berries. It is readily propagated, and no soil comes amiss to it.

The Venetian Sumach (*Rhus cotinus*).—This is a much neglected shrub, but for general usefulness can hardly be surpassed. It is highly ornamental, whether in flower or fruit, the feathery inflorescens rendering it of quaint and curious appearance, particularly when a well-grown plant is under notice. It is peculiarly well suited for planting in cities. A sound loam, neither too damp nor yet too dry, suits it to perfection.

The Stag's Horn Sumach (*Rhus typhina*).—This must on no account be omitted, as it is a plant of pretty and curious appearance, grows with freedom, and is as hardy as could be desired.

Leycesteria formosa is a beautiful hardy shrub, with hollow stems, large ovate leaves, and white or purplish flowers in pendulous racemes. More conspicuous than the flowers are the deep purple foliaceous bracts, which impart to the shrub a distinct and very ornamental appearance. It is a capital town plant, shooting out fresh and green after being subjected to a winter's incessant fumes from the chimneys of the great metropolis. It is perfectly hardy, of free growth, readily propagated, and altogether a valuable shrub.

The Flowering Currant (*Ribes sanguineum*).—Too much praise can hardly be bestowed on this handsome free-flowering shrub for the planting of town gardens and shrubberies. There it succeeds to perfection, and flowers with the greatest freedom. In early spring it breaks out fresh and strong, regardless of the noxious fumes and impure atmosphere. Well planted at first, it rarely fails, striking out its roots far and wide, and soon becoming a dense shrub of medium proportions. Nothing can well surpass it for the quantity, colour, and quality of its showy flowers, while it is the easiest of shrubs to propagate and cultivate.

Skimmia japonica is a low-growing shrub that I have seen doing well in the heart of London, where smoke and other impurities of the air do not seem to affect it in the least. For beauty of flowers it is not remarkable, but as a handsome berry-bearing shrub it can well hold its own with any other. A north aspect, and half-peaty soil would seem to suit it.

The Snowy Mespilus (*Amelanchier Botryapium*), with its racemes of white flowers and desirable outline, is a valuable shrub for planting in towns. The flowers are produced in early spring, when lawns and gardens look dull and cheerless. Of free growth, it succeeds in any fairly good soil, and soon forms a handsome specimen.

Lilacs have few equals as town shrubs; indeed, it would be good practice to plant these first, whatever else might follow. They succeed admirably in the worst and most smoky parts of London and Glasgow, and there put on an appearance during early summer that it would be difficult to exceed in country gardens. Recent experiments have proved that many of the finer forms are equal to the common kind for this purpose, particularly the Siberian and Persian. All are of free growth, non-fastidious as to soil or site, and easily propagated.

The Kentucky Coffee Tree (*Gymnocladus canadensis*) can ill be spared from any list of suitable subjects for the town garden, it having been proved to be an excellent plant for the purpose. The racemes of white flowers which it bears are particularly showy and interesting.

The Bladder Senna (*Colutea arborescens*) is entitled to rank high amongst town shrubs, for it may be seen flowering and fruiting in the most smoky parts of many of our largest cities. It does well in the very centre of London, and is largely planted in Liverpool, Manchester, and Glasgow. The pretty yellow flowers, and the curious bladder-like seed-pods, are both showy and interesting, and render the plant one of the brightest shrubbery ornaments during nearly half of the year. Few soils come amiss, but it succeeds best in a warm and sunny position, and is well adapted for use as a wall plant.

Phillyrea Vilmoriniana.—This has been planted largely for experimental purposes in the very heart of London, and succeeds there in such a way as to entitle it to rank first amongst shrubs for town planting. It is a shrub of neat habit, is an easy subject to deal with, and requires the least of attention.

Forsythia viridissima is another deciduous shrub that can withstand the fumes and smoke of towns. It grows with the greatest freedom in very vitiated atmospheres, each spring breaking out as fresh and green as if it were growing in a sheltered country garden. Of vigorous constitution, it grows freely, and flowers most profusely in the largest cities. Stiffish soil suits it well, but it is far from particular in that way, and stands hard trimming in of its shoots with impunity.

The Strawberry Tree (*Arbutus Unedo*) finds a congenial home in the great metropolis, and there may be seen flourishing, where daily it is subjected to poisonous emanations from chimneys. The thick, leathery leaves seem well able to resist the worst of town air impurities, for they look as fresh and green after every shower of rain as could well be desired. As an ornamental shrub the Arbutus ranks high, the creamy flowers and strawberry-like fruit being peculiarly rich and attractive. Any soil of good quality, but not surcharged with moisture, grows it well.

The Double Furze (*Ulex Europæus flore pleno*) is one of our handsomest flowering shrubs, and is of great value for planting in town gardens and squares. For clothing warm and dry banks, where few other plants would succeed, furze does remarkably well, the foliage being thick and healthy, while the flowers are abundantly produced. It is of neat habit, and by judicious pruning may be kept to any desirable size.

The Spurge Laurel (*Daphne Laureola*) grows freely in many a town garden; indeed, it is no uncommon thing to see large and well-balanced specimens where smoke and filth are the order of the day. It is a pretty evergreen shrub, of free and vigorous growth, and one that is well able to take care of itself under almost any conditions. It does well in the shade, and under the drip of other trees, though it is all the better of a sunny site, but not too exposed a situation. It is readily propagated, and young plants are usually found in quantity where old, established specimens abound.

Cotoneasters of various kinds succeed well as town plants. All or nearly all are valuable for covering bare and unsightly objects, and as they grow well in the roughest and poorest of soils, they may be used in positions where other less accommodating subjects will hardly succeed. As ornamental plants, many of the Cotoneasters are highly valuable, from their neat, glossy leaves and abundance of brightly-coloured fruit. Particular mention may be made of *C. frigida*, with its large clusters of scarlet berries; *C. Simonsii*, with silky foliage and vermilion fruit; and our native *C. vulgaris*, a neat and hardy as well as free-fruiting species.

Euonymus japonicus is another excellent shrub, one that succeeds admirably wherever it is planted. It bears trimming well, and so can easily be kept to any required dimensions. For free growth and a hardy nature it has few equals. It is not particular as to soil, and is an excellent dry-weather plant, easily propagated, and almost smoke-defying.

The double-flowered variety of *Prunus sinensis* is hard to match, either for beauty of bloom or as regards its fitness for planting in our smokiest thoroughfares. In many of the worst smoke-infested districts of London and Glasgow, it and *P. triloba* appear in quite as good form and health as if they were growing in the open country. They are excellent hot-weather plants, for after hot and dry summers they do not seem so hard pressed as are many of what would be considered more robust subjects. Fairly good soil, and not too draughty a position, is all they need, while their after-management is of the simplest.

The Almond (*Amygdalus communis*) and *A. c. nana* have proved themselves to be useful plants for doing battle with the smoke and impure air of towns. They are both highly ornamental when in flower, not fastidious as to soil, and of neat habit. In and around London almonds are largely planted, as they are so ornamental, so free in flowering, and so easily managed. Of the typical *A. communis* there are numerous distinct varieties, including some with much larger and brighter flowers, one of the best of which is *A. communis major*.

Kœlreuteria paniculata is a very handsome shrub or small-growing tree, particularly when in flower, and it is one of the best of town plants. In many of our most smoke-infested towns—Warrington, and the outskirt districts of Liverpool and Manchester—it grows with great freedom, and produces in great abundance, during June and July, its panicles of showy yellow flowers. Although the *Kœlreuteria* hails from China, it may be relied upon as perfectly hardy in perhaps every part of the British Isles.

The Laurustinus (*Viburnum Tinus*) finds a congenial home in many a London garden, where it has proved itself to be a decided acquisition. It is a plant of bright appearance, and as free-flowering a subject as there is in the whole range of hardy shrubs. Cuttings inserted in sandy soil during August root freely, and soon form sturdy plants that in a couple of years are fit for transferring to their permanent quarters.

Weigelia rosea and *W. amabilis* are both highly ornamental shrubs, of the freest growth, and well suited for planting in smoky localities. In many of the London gardens these shrubs may be seen in a satisfactory state, showing but few of the bad effects that generally attend town shrubs. Both are of simple culture, easily propagated, and not fastidious as to the soil.

Deutzia scabra is another neat-growing and highly desirable plant for the town garden. It flowers, in such situations, with unusual freedom, ripening its young wood well, and showing but little traces of its struggle with the impure atmosphere. It may be trimmed in at will, is readily propagated from cuttings, and succeeds well in a great variety of soils and situations.

The common Box (*Buxus sempervirens*) and the Tree Box (*B. sempervirens arborescens*) are largely used in town parks, squares, and gardens. The thick leathery foliage is well suited for withstanding impurities in the air. The tree box thrives better than the normal plant in the heart of our largest centres of industry.

The Gum Cistus (*C. ladaniferus*) and the laurel-leaved form (*C. laurifolius*) are two highly ornamental and perfectly hardy shrubs. The former has large white flowers, with a distinct purple blotch at the base of the petals, while the robust-growing *C. laurifolius* has pure white flowers. Both are excellent town plants, succeeding well even in very populous localities.

Mahonia aquifolia, *M. Bealii*, and *M. japonica* all do fairly well in the town garden, but are the better of being assigned to select positions in the open. Good vegetable mould seems to suit the various species of Mahonia, and when once fairly established they grow and flower freely. All are shrubs of great beauty, the bright and showy flowers, produced in rich profusion, are followed by abundance of clusters of rich bluish-purple berries.

The Japan Quince (*Cydonia japonica*) is one of the most beautiful shrubs with which our gardens have ever been enriched; and from the number of fine healthy specimens that are to be found in many of our largest towns, it would thus appear to be particularly suitable for planting where soot and smoke are prevalent. The brilliant scarlet flowers, which are produced at a season when such are most in want, impart to well-grown specimens a beauty which is almost impossible to describe. It is perfectly hardy, not fastidious as to soil, and of free and easy growth.

Hypericum Nepalense is the best of the St John's worts for withstanding smoke, dust, and heat. It is a plant of great beauty, the bright foliage and abundance of large golden flowers placing it in the first rank as an ornamental plant. *H. calycinum* is also valuable for similar purposes; while for edging to the shrubbery, or for covering bare spots, it has few equals.

Euonymus japonicus and its silver and golden forms are most useful town shrubs, for they succeed well in very smoky and filthy localities. They are plants of great beauty, particularly the variegated varieties, of easy culture, and not at all particular as to soil in which they grow. *E. radicans* is a straggling, decumbent shrub, and, as it stands soot and smoke well, it is suitable for planting as a dwarf plant in the town garden and square.

Climbers.

Of shrubs suitable for covering walls, trellises, and arbours, and at the same time able to resist the dire influences of smoke and soot, there are a few valuable and well-tried kinds.

The Virginian Creeper (*Ampelopsis hederacea*) has few equals as a town plant, succeeding perfectly in the midst of our busiest centres of industry. Many instances could be pointed out where this handsome climber grows with the greatest freedom in the most impure and smoke-laden atmosphere, constantly exposed to the foul air, heat, and dust. It grows freely in any soil of ordinary quality, and soon covers a great extent of wall. The deeply-cut ornamental leaves change to a bright red colour in autumn, and are then particularly handsome and pleasing.

The common Ivy (*Hedera Helix*) is, perhaps, the most valuable of all climbing plants for planting in smoke-infested localities. In some of the courts near Ludgate Hill, a district of London that is by no means free from smoke and foul air, the ivy climbs the houses to a height of 60 feet, and surprises one by its fresh appearance in such a locality. It needs no training, and will succeed admirably in soil composed largely of old mortar, stones, and the smallest quantity of loam.

The Evergreen or Trumpet Honeysuckle (*Lonicera sempervirens*) is another shrub of great merit for town planting, as it thrives well in very confined spaces, and where the atmosphere is very impure. It is one of the handsomest of the honeysuckles, bearing a rich profusion of sweet-scented flowers in early summer, and requiring no special treatment or cultivation. It and the Virginian creeper require their young shoots to be fastened to the wall.

Cratægus Pyracantha is a most useful wall shrub for the town garden. It is of free growth, stands smoke well, and is one of the handsomest berry-bearing plants in cultivation. The variety known as *Lelandii* is, however, preferable to the normal plant, both for beauty of flowers and fruit.

The *Jasminum nudiflorum* needs little description, as it is one of our commonest wall plants. For smoky districts it is invaluable, blooming freely when flowers are scarce, and seeming to heed but little the impurities of a town atmosphere. Of free growth, it is well worthy of extended culture.

The Vine (*Vitis vinifera*) must not be omitted from any list of town climbers, for it bears exposure to soot, smoke, dust, and heat in a surprising manner. In many towns it may be seen doing well, and covering large areas of wall with its large finely-divided leaves. There are several cut-leaved forms, one or two of which are, perhaps, more ornamental than the typical plant.

Several other climbing wall-plants do well in large towns where excessive quantities of smoke are absent, but the above may be relied upon as those that are best suited for planting where the atmosphere is constantly vitiated with impurities.

Coniferous Trees.

Few of these, if any, succeed in a satisfactory way when constantly subjected to the impurities of a town atmosphere. Where the conditions are favourable, the Austrian pine (*Pinus Austriaca*), *Thujopsis dolabrata*, deciduous cypress (*Taxodium distichum*), and Lawson's cypress (*Cupressus Lawsonii*) do fairly well, but they are not to be recommended for general town planting. *Retinospora plumosa aurea* stood for five years in one of the most smoke-infested districts of Glasgow, and looked almost as well as it did when brought from the country.

Other Plants.

Yuccas of various species are to be highly recommended for planting, even in very smoky and confined districts. They grow with great freedom in many of the London gardens, as also in Glasgow, Liverpool, and Manchester. Irises, notably *I. Germanica*, do well even in very smoky and confined districts, as they have a marvellous recuperative power after being subjected to the heat, dust, and general impurities of a town atmosphere. Auriculas and border carnations also do fairly well, but they will not stand constant smoke and soot; and the same may be said of various species of hellebore, Virginian stock, *Eranthis hyemalis*, and chrysanthemums.

Much may be done to keep plants fresh and healthy by free use of the watering-pot, syringe, and hose, and also by carefully looking after insect pests, and stamping them out as they appear. The combination of adverse circumstances to be encountered in growing plants in smoky towns is great indeed, and should only be engaged in when special care and attention can be bestowed on their culture and general management.

The foregoing list of trees, shrubs, and other plants includes only such kinds as can be confidently recommended as suitable subjects for planting in town parks and gardens. A great many others might have been added to the list, but we consider it better only to include well-tried kinds.

For convenience we have arranged the following list in an alphabetical manner, so that any one can see at a glance the kinds which are best suited for withstanding the deleterious effects of an impure atmosphere.

TOWN TREES.

Acer macrophylla.
Acer pseudo-platanus.
Acer pseudo-platanus variegata.
Æsculus Hippocastanum.
Ailanthus glandulosa.
Alnus cordifolia.
Betula alba.
Carpinus Betulus.
Catalpa bignonioides.
Cerasus (Prunus)
Cratægus Oxyacantha.
Cratægus Oxyacantha flore pleno.
Cratægus tanacetifolia.
Fraxinus excelsior pendula.
Gleditschia triacanthos.
Ilex aquifolium.
Ilex Balearica.
Ilex Hodginsii.
Juglans nigra.
Juglans regia.
Liriodendron tulipiferum.
Magnolia acuminata.
Magnolia glauca.
Morus alba.
Morus nigra.
Olea Europæa.
Pinus Austriaca.
Platanus acerifolia.
Platanus orientalis.
Populus alba.
Populus canadensis.
Populus fastigiata.
Pyrus aria.
Pyrus aucuparia.
Quercus cerris.
Quercus Ilex.
Retinospora plumosa aurea.
Robinia pseud-acacia.
Robinia pseud-acacia Decaisneana.
Robinia pseud-acacia macrophylla.
Robinia viscosa.
Salix fragilis.
Salix purpurea.
Sophora japonica.
Taxodium distichum.
Taxus baccata.
Tilia Europæa.

TOWN SHRUBS.

Amelanchier Botryapium.
Ampelopsis Virginica.
Amygdalus nana.
Arbutus Unedo.
Aucuba japonica.
Berberis aquifolia.
Berberis vulgaris.
Buxus Balearica.
Buxus sempervirens.
Cistus ladaniferus.
Cistus laurifolius.
Colutea arborescens.
Cotoneaster frigida.
Cotoneaster Simonsii.
Cotoneaster thymifolia.
Cotoneaster vulgaris.
Cydonia japonica.
Daphne laureola.
Daphne Mezereum.
Daphne pontica.
Deutzia crenata.
Deutzia gracilis.
Euonymus japonica.
Forsythia suspensa.
Forsythia viridissima.
Griselinia littoralis.
Gymnocladus canadensis.
Hedera Helix.
Hibiscus syriacus.
Hypericum calycinum.
Hypericum Nepalense.
Kœlreuteria panniculata.
Leycesteria formosa.
Ligustrum coriaceum.
Ligustrum ovalifolium.
Osmanthus ilicifolius.
Philadelphus Gordonianus.
Philadelphus grandiflorus.
Phillyrea angustifolia.
Phillyrea latifolia.
Rhamnus frangula.
Rhus cotinus.
Ribes aureum.
Ribes sanguinem.
Ribes speciosum.
Skimmia oblata.
Syringa Josikæa.
Syringa Persica.
Syringa vulgaris.
Ulex Europæa flore pleno.
Viburnum opulus.
Weigelia rosea.
Yucca gloriosa.
Yucca recurva.

IX. *The Utilisation of Small-Wood for Turnery and other Purposes.* By A. T. Williamson, 7 Kew Terrace, Edinburgh.

The profitable disposal of the large quantities of small-wood necessarily produced from the clearing of large timber is a question that would seem to have passed beyond the reach of ingenuity to solve. The changed position in which this country has been placed has been entirely brought about by the introduction of manufactured small-wood goods from America; and these having been received by thread and textile manufacturers with a considerable degree of favour, the trade has gradually developed to large dimensions, and now it forms a very important item in the list of the country's timber imports. It is doubtful if this favour was bestowed on the American produce because of its superior quality for bobbin-making, seeing that considerable divergence of opinion still exists on that point. The outstanding fact that these goods were supplied at a price little beyond one half of that usually paid for the home manufactured article, was the main fact that weighed with the consumer in deciding to supply himself with the imported article.

At first the American consignments were very limited in amount, only small parcels being sent as an experiment by the regular steamers to the principal British ports. The greatly reduced price at which they were sold was a point that attracted the attention of the consumer, and was an influence impossible to resist. Finding the goods suited the purposes for which they were intended equally well with those he had hitherto been accustomed to use, a successful development ensued as a natural consequence. The new departure had the effect of stimulating the genius of the turner and mechanical inventor on this side, which led to the construction of machinery with a greater capacity for production, and the invention of appliances that would reduce the cost of labour. In this a large advance was made in the direction of rapid and cheap production. Notwithstanding continued and renewed efforts, the home producer felt himself so largely handicapped that the industry of turning to a great extent declined, and as a consequence reduced the value of the class of small wood that had hitherto found an outlet in this direction. Much machinery that had been constructed specially for bobbin work fell into disuse, and great loss was occasioned to the bobbin manufacturer thereby.

Constant supplies, in large quantities, of American bobbins are forthcoming, particularly to the Clyde and Mersey markets, and now appear in the weekly import list as a matter of course. To a limited extent, however, the bobbin-turning trade is still carried on, and in centres where supplies of suitable wood can be obtained, without being subject to excessive outlays for railway carriage, some large turning establishments exist. This altered condition of the trade has reduced the value of all kinds of small-wood to the lowest margin. In this paper it is proposed to describe the manner in which the small-wood of the various kinds of timber is disposed of and utilised, and sundry purposes for which it is and may be used in different districts of the country.

Beginning with the oak, the amount of small-wood produced is very considerable, and, like the bobbin-wood trade, the outlet of former years for vast quantities has been shut up by the revolution in shipbuilding. The age of our wooden walls has given place to iron, and the enormous consumption of tree-nails which were necessary in the building of the wooden ship is now no longer required in the iron. These tree-nails, being small in size, were chiefly manufactured from what may be termed the waste oak. A limited quantity is still consumed by turners, in the manufacture of oak bungs or stoppers for barrels. These are taken from wood from one to two inches square, and of same length. Specially constructed machinery is used for the production of these articles, by means of which a long length is crosscut to the desired size of pieces simultaneously with the process of turning. A very important outlet for small oak wood is perhaps less generally known in Scotland than it ought to be. This outlet exists in the brass and copper manufacturing districts, where large quantities are consumed, and that in the most effectual way. The purpose to which this class of wood is applied is to burn it in the furnace where the metal is being smelted. The wood must be light, down to an inch in diameter, but it is essential that the pieces be supplied in considerable lengths and moderately straight, having to pass through the narrow furnace door. The object served in the burning of the wood in this manner is the refining of the metal, and the process is by stirring the molten material with the oak wood. It can at once be understood that it can withstand this process for only a very limited time; the demand is therefore great and continuous, and very remunerative prices are obtainable for suitable wood. The only purpose to which short small pieces of oak can now be put is that of pit-props and pit-chocks—the former in any size down to 2 inches diameter and 2 feet in length, and the latter sawn square to 2 inches and upwards, by 18 to 30 inches in length.

The ash small-wood is produced still more extensively than the oak, but finds a greater variety of purposes in which it may be utilised. The turner looks on it with much favour as a turning wood. The serious collapse brought about in the bobbin manufacturing trade, through the causes already referred to, has curtailed the demand to such an extent as to reduce the price obtainable for turning wood by one half. When it can be delivered in those districts where bobbin-turning establishments still exist at the rate of 22s. to 24s. per ton, any quantity may be utilised. A greater restriction is, however, now placed on it in respect of size. In former years wood down to an inch in diameter was passable, but now 3 inches in diameter is as small a size as is deemed useful for bobbin work. A very important outlet for the consumption of small and waste ash is to be found in the agricultural implement trade. The quantity of small turned goods required in this industry is extensive, and these are very varied in their sizes and description, ranging from 1 inch diameter by 4 inches long to any size upwards. The items consist of handles for all kinds of implements, ornamental turned pieces, small shafts, etc., too numerous to detail, and all convertible from what may be termed small and waste wood, and ash is the wood invariably stipulated. In some of the Ayrshire establishments, where the supply of this class of turned wood is made a leading feature, thousands of tons of ash are annually consumed in the agricultural implement department. The hay-rake is a tool that bears greater importance to this subject than its insignificance would lead one to suppose. The enormous number that are in constant use everywhere, and the continuous demand for them, constitute their manufacture an item of considerable account in the ash trade, and in it is worked up the smallest pieces of wood. Fortunately this branch, unlike the bobbin trade, has been able to maintain a successful competition against the American products. This may be explained in some degree by the inferiority of the quality of American-grown ash compared with our tough grown wood. The fancy and ornamental box and toy trade only to a small extent utilises the small ash, and the outlet in this direction is of little moment, although at the same time it must be said that in this direction there exists a field for consumption of small ash. The peculiarly pleasing figure that is producible from the manufacture and polish of ash makes any ornament or fancy article most attractive. It is impossible, when referring to the fancy box and ornament trade, to omit making mention of the fact that cannot be overlooked, that in any district of the country where one may desire to purchase an ornamental article as a reminiscence of a visit, the words now too commonly engraved are to be found "Made in Germany," or some other Continental country, and even in the famed land of Burns the writer has been confronted in the very centre of the fancy box manufacturing trade with a fancy wood ornament displaying on it some event in the history of Scotia's Bard, and in addition in some corner the ominous words above referred to neatly engraved. The remedy to counteract this condition of the fancy wood trade is to be found in two directions —first, such improvement in the mechanical appliances as will cheapen manufacture and production; and second, by the stimulating of the popular mind to practise the sentiment of patriotism. Were the supply of such articles reasonably confined to home manufacture, the amount of small ash that would consequently be consumed would very materially affect its value, and to some extent remove a reproach, and mitigate the drug that it at present experiences in the market. Much ash wood that is at present forced into the pit-wood trade would thereby find a more remunerative outlet in the direction for which it is so admirably suited.

The sycamore is the only description of wood that has fully maintained its position in the turning trade. The small wood produced from heavy trees is a large item, and the same demand exists for this peculiarly fine wood for manufactured and turned work. The closeness of the grain makes it susceptible to a fine polish, and the pure white colour gives it great favour where a superior description of bobbin is necessary. The smallest size of wood is therefore utilised by the turner for the manufacture of small bobbins. The demand has, therefore, remained undiminished, the American production of bobbin coming specially in competition with the more common quality of bobbin manufactured from such woods as beech, birch, or ash, has not so appreciably affected the sycamore. The same outlet, therefore, exists for our available supply, and consignments of very small wood are regularly sent to the various markets, both English and Scotch, where the industry of bobbin turning is still carried on. The outlet in the famous Ayrshire fancy ornament factories has greatly fallen off, but the loss of this has not been so grievously felt in the case of sycamore as in that of ash, &c., seeing the open market remains for the sycamore for bobbin requirements. The manufacture from this wood of domestic utensils has for some time considerably declined, for the same reason that is assigned to the diminution of the fancy ornament trade.

The wood that has suffered in the curtailment of demand for its waste and small sizes is beech, on which wood was relied the supply for the manufacture of common quality of bobbins. No other variety of timber produces such an extent of top and small sizes as the beech, and the proprietor of any quantity is often perplexed as to the course he must adopt to dispose of it. Its excessive weight absolutely prevents its being conveyed any lengthened distance, and seldom is beech secured in sufficient quantities in one district as to warrant the erection of sawmill plant for the exclusive purpose of cutting up the tops and limbs. In the event of a sawmill being erected for the purpose of converting other wood in which beech may be contained, it is quite practicable to utilise with profit every particle of small beech, by sawing it up into the squares from which the bobbins are turned, and after seasoning for a few weeks, the weight has been so reduced as to effect a saving of from 50 to 60 per cent. on the carriage. But this is the only means where small beech in a country district may be disposed of, otherwise, under the present conditions, it is almost necessary to leave the wood on the ground, as is frequently done, or allow it to be taken for firewood at a small price. There are certainly other outlets for small beech, such as tool handles, ornamental turned pieces of furniture work, etc., but the supply necessary to meet this demand is more than met by the waste wood created in the conversion of the tree timber, which is always done at a town or central sawmill. Recourse may be had to the manufacture of pit-chocks, which are from 2 inches square and upwards by 2 feet long; but to make this profitable, it is necessary that a sawmill should be adjacent, pit timber of all kinds having a place amongst the lowest-priced timber goods. The present difficult position as regards small beech remains therefore unsolved.

The remarks stated as regards beech are equally applicable to the birch, and the wood, of a size too small for the manufacture of clogs, to which purpose this tree is chiefly put, is rendered unfit to be profitably utilised, unless grown in a district near to a saw-mill, where squares may be cut for the bobbin turner.

The pit-prop trade is brought into requisition for the disposal of the small-wood of elm, poplar, larch, fir, etc. The horse chest-nut is a favourite turning wood, but meantime suffers under the same disabilities as the beech and birch, and is obliged to fall in with the others in the pit-wood market. The growing adoption of the cross-cutting of all small-wood immediately on the ground where it is grown, and stacking it up for a short period, effects such a saving in the cost of conveyance as to cause greater attention being directed to this hitherto unremunerative branch of the timber trade.

X. *The Manufacture of Home-grown Timber.* By A. T. Williamson, Edinburgh.

The ever-changing conditions under which the industries of our country are conducted, and the revolutions that are continually taking place in the production of commodities, naturally affect the demand for the raw materials that are necessary for the production of the manufactured article. In this respect the preparation of no other raw material has been more liable to change from time to time than that of home-grown timber; in fact, the substitution of foreign for native produce, the adoption of varieties for the same purpose, and the new industries brought into existence by the inventor's genius, have within the past few years almost completely revolutionised the methods of conversion of timber. The modes of cutting-up, and the purposes to which a tree was applied, say, twenty years ago, would be considered by the timber merchant of to-day as utterly wasteful. In this paper I propose to give a brief outline of the most economical methods of cutting out the various kinds of timber, and the uses to which each variety is applied, with a few hints on the utilisation of the enormous amount of waste that is necessarily produced by the conversion of round timber into square scantlings, a matter which, in the present keen competition, is one that is perpetually exercising the minds of the convertor, and on which to many the question of a profit or loss in the conduct of his business altogether depends. The controversial subject of the cutting-up of timber on the site of the forest by means of a portable sawmill, although coming within the scope of such a paper as this, has so many sides to it that it may well form an interesting and lengthy paper by itself. However, the remark may be made in passing that there is an increasing disposition to encourage the mechanical inventor in his efforts to furnish appliances better adapted for the more effective and economical conversion of round timber in the precincts of a forest.

I will begin by taking up each kind of tree separately, and begin with that favourite tree of which it is said not an atom need be wasted from the root to the acorn, viz., the oak. The past fifty years has completely revolutionised the uses to which the oak is put. In the industrial world it still takes a high place, and innumerable are the purposes for which it is used, but the largest portion of home supplies find their way to the railway waggon shops. The conversion of a fall of oak necessitates, from the uneven nature of the sizes, shapes, and qualities of the trees, a very careful assortment. The clean and straight trees of small dimensions may be more profitably utilised for cleft purposes, more particularly spokes for wheelmaking. In some districts of the country, field gates are largely manufactured from cleft oak. These, being 9 or 10 feet long, must be taken from trees perfectly straight in the grain and without knots. The same class of tree is generally used for the purposes of cleft spokes for wheels. In the selection of trees for cleaving purposes, it frequently happens that although externally they bear every indication of straightness of grain, and all the appearance of being perfectly adapted to such work, they turn out when opened up to have such flaws as entirely prevent their profitable manufacture, and a large allowance for loss must therefore be calculated upon. In the case of cleaving for wheel spokes, the lengths are so very much shorter, namely, from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet, that the loss is proportionately less. These lengths may also often be cut out of a tree between the knots and curled defects, but as a rule only the root cut off a tree is at all suitable for any cleft purpose. The favour bestowed on cleft spokes by wheelmakers maintains this branch of oak manufacture in undiminished volume, and notwithstanding the intense competition which nowadays they experience from sawn spokes, and prepared spokes of American finish, they still command a price far in excess of either. The size of the spokes in general use vary much, particularly in breadth and thickness, according to the kind of vehicle for which they are intended. The smallest size of carriage spoke is about 2 inches in breadth by about 1 inch in thickness. Other vehicles require heavier wood, so that every size is manufactured, gaining half an inch on each kind, up to those required for heavy lorries and gun carriages, which are often 5 inches by 3 inches. In clearing a lot of suitable oak, it is therefore not only judicious but necessary that all the sizes be manufactured at the same time, in order that a tree may be altogether and profitably utilised. Afterwards the sorting of the spokes can be easily carried out. In the south a very popular description of oak cleft fencing uses up considerable quantities of this class of timber. These pales, as they are called, are usually about 3 feet high, 3 inches broad, and about half an inch thick. In cleaving any of the before-mentioned commodities, it not infrequently happens that numbers of good pieces of wood come off either too small, or otherwise deficient, to make a spoke, in which case such pieces are utilised for ladder steps or rounds, the common size of which is $1\frac{1}{2}$ inch square. Nothing can be compared with these for strength, and were they always employed by ladder makers, many serious accidents would be prevented. In converting small and suitable trees into these commodities, little or no waste is made, further than the necessary amount of chips and shavings, so that the whole is profitably utilised.

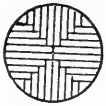
The larger timber was principally used in former times for shipbuilding, but since "wooden walls" have given place to iron ships, a very limited amount of oak is now applied to that purpose. The introduction of railways, however, has opened up a new field for the consumption of heavy oak timber in the shape of waggon-building, and so great is the demand from this source that our home supply has fallen far short of it, with the result that the importation of American oak has enormously developed, first by shipments of the logs, and conversion of them on this side of the water, and within recent years by having the exact sizes for waggon construction cut in America, and imported direct to consumers. In this way not only is the country deprived of the revenue derivable from the raw produce, but much loss is also sustained from our labourers being deprived of a large amount of work in the sawmills. The available oak timber of a suitable size produced in our own country is almost exclusively utilised for this purpose, and from its superior quality it is held in greater favour, and commands a higher price, than the American oak. In the cutting out of waggon wood, a very comprehensive specification of lengths and sizes is fortunately available, otherwise the amount of waste would be ruinously great. The first and important item in the specification of a set of waggon timbers is, the sole beams or trams, which vary from 14 feet to 17 feet in length, but exceptional lengths may be a little shorter or longer, the breadth being from 11 to 12 inches, and the thickness from 4 to 5 inches. These must be cut from absolutely straight trees, and are the first to be selected. The large scantling necessarily entails the throwing off of heavy slabs, or outside pieces, amounting often to nearly one half of the cubical contents of the tree; but, as already mentioned, the specification embraces about twenty sizes of smaller dimensions, which are economically manufactured from these thick outside slabs. The smaller sizes run down to 4 inches by $1\frac{1}{2}$

inches, so that in preparing the set the whole timber is utilised. A waggon specification always contains a size of from 7 to 8 feet long, of the same scantling as the trams, which is profitably cut out of short butts, a class of tree which is too common in all lots of oak timber. The slabs, from the preparation of the principal trams, cut from the heavy bole of the tree, are not generally sufficient to complete the specification, and this affords the opportunity of utilising the top of the tree upwards from the cross-cutting of the butt for the tram, and makes up the necessary amount of raw timber to complete the smaller sizes of the specification. When the specified timber is completed, there will be found odd pieces left over, mostly of smaller sizes. These are usually converted into railway sleeper keys, of varying lengths, down to 6 inches, and thus work up all these pieces. With a little study and care the manufacture of waggon timber can be thus carried on without entailing any appreciable amount of loss or waste. The cubical contents of the manufactured scantlings may with care amount to the cubical contents found by the taking the quarter girth of the round tree, and sometimes to even more.

Turning to crooked oak timber, the demand for which has been very much restricted by the substitution of iron for wood in shipbuilding, there is sometimes experienced difficulty in getting immediate use for it. On the whole, however, there is still sufficient demand to absorb the supply, certain classes of special vessels necessitating the consumption of what produce is generally forthcoming outside of ordinary shipbuilding. Vessels for the African trade, and those similarly built, using up the most of the timber of this description. Although the field of outlet is limited for this class of wood, it is never likely to be subjected to the competition of foreign supplies, as the expense of importing a cargo of crooked timber is too serious to be entertained; the carrying capacity of a ship could not be profitably utilised by loading a cargo of crooks.

Very heavy oak of large dimensions, say 2 feet and upwards, retains its high value, and is utilised for cabinet work and other special purposes. For these the tree must be sawn across the quarter, in order to produce the "figure" for which the oak is famous. To obtain the full volume, it is absolutely necessary that the tree be cut over the quarter, and, if properly done, no other oak can compare with our home produce for beauty and excellence.

Several systems are adopted for the procuring of the richest and fullest figure, but it is generally admitted that the best and most profitable is shown by the following diagram :—



By this means every board is obtained as nearly across the grain as ingenuity can devise. It will be seen, that in order to get boards of a certain size, a tree of double the size required is necessary. Thus a tree 2 feet across will produce a few boards about 12 inches broad, gradually diminishing from the centre outwards, and it is seldom therefore that a tree under 2 feet through is used for cabinet work, the favourite size being from 30 inches upwards. Timber suitable for this purpose commands the highest price, varying from 6s. to 10s. per cubic foot.

In a lot of oak it is invariably found that there are a certain number of trees which must be classed as secondary in point of size, shape, and quantity, and the disposal of these is often a source of some difficulty. The slightness of the crook may incapacitate their use for waggon timber, and at same time it is not fit for ship crooks. With this class of timber the wheelwright is a necessity; cart timbers, being short and of a small size, are manufactured from it, such as slots, trams, etc., while the smaller scantlings are converted into sawn wheel spokes. These spokes are, however, much inferior to the cleft spokes previously described, and command only a fraction of the price. This class of oak timber is consequently of the smallest value for manufacturing purposes.

The only part of the oak tree now remaining unutilised is the top, limbs and branches, and these unfortunately have now been placed in the lowest category, the former uses to which they were applied by turners having become almost extinct. A wholesale conversion into pit-props is therefore commonly resorted to, the smaller sizes down to 2 inches being used whole, while the larger sizes are quartered or reduced to meet the demands of the numerous requirements in coal and iron mines.

In some parts of the country a favourite item in agricultural districts is oak gate-posts. These are manufactured from the heavy wood of the class last referred to, and being from 5 to 8 feet long, and from 5 inches square upwards, the trees are economically utilised in this way. The part to enter the ground is left in its rough state, and that above ground is sawn square to the desired size.

The preceding gives a description of the principal uses to which the oak is put, but there are many others, a description of which, however, would only be a repetition of those given. The oak forms the staple article in the woodyard, and certainly in its conversion requires more study and ability, acquired by practice, than that of any other tree, to enable the full amount of the tree to be profitably utilised.

The ash ranks high in importance and usefulness amongst our native trees. Its elastic properties, and the toughness of its fibre, makes the tree of great value for numerous industrial purposes, and this fact has maintained for it the high value at which it is rated. Equivalent substitutes in respect of these qualities have not been found in importations from abroad. The insufficient home supply has for many years necessitated the substitution of foreign wood to meet the growing requirements, but its inferiority is grievously felt.

In the manufacture of ash, long lengths are not the great consideration, and crooked growth is no objection for many purposes to which it is applied, especially for shaft wood. Cart and waggon shafts consume a considerable portion of this timber. These vary in length from 8 to 12 feet, and from 2½ inches to 4 inches thick. They are cut from the best butts, which as a rule contain a bend suitable for the article required. Straight clean butts are also largely used for broad hoops, which are more frequently cloven in long lengths from 6 to 10 feet. In their manufacture a process of steaming has to be undergone, making the piece perfectly pliable, so as to make a regular circle. Timber suitable for this purpose commands the highest price, and in its manufacture by cleaving little or no waste occurs.

A large quantity of ash timber is used for handles for spades and shovels. The timber for this purpose is planked to 1½ inch, and sawn out by a band-saw to the shape required in the handle. These being generally of a bent shape, there is necessarily a considerable amount of waste wood, but this is converted into bobbins and other small turned goods, for which the demand is practically unlimited in the manufacturing districts. The coach-building trade makes large demands on ash timber, but these lie in the direction mostly of boards and planks, which in their production require no great amount of study or skill, the tree being merely planked to the desired thickness without having regard to the nature of the bend.

Cabinetmakers consume considerable quantities of choice ash wood, and for this purpose the cutting of the tree on the quarter is a desiderata. The figure of the ash thus shown, although not to be compared with the oak, has a peculiarly rich and satiny appearance. The same industry consumes its full share of second class wood, in the shape of turned pieces of furniture; and being used in short lengths, it largely assists in utilising waste made from the manufacture of more important articles.

The trade which consumes perhaps more ash than any other is that of the wheelmaker, for felloes. These being segments of a circle, must be cut from trees having the necessary crook. The breadth of felloes vary by half inches from 2 to 6 inches, and the tree is planked with the bend to these thicknesses, after which the pattern is drawn, and the planks reconverted by means of the band-saw. A tree with the proper crook entails little or no waste, but this cannot at all times be obtained, and considerable quantities of odd pieces are consequently created, and to utilise them recourse is had to the turner, who manufactures bobbins, etc., from them. In cutting out felloes it is necessary that only the very crooked timber be used. Cartwrights consume considerable quantities, but the increasing price of this wood, consequent on its scarcity, has of recent years sent them to the elm for the principal part of their wants. The common or smaller class of ash timber is used in some districts for staves for dryware casks, which vary in length from one foot upwards. In other districts it is exclusively used for turning purposes, while small branches and very rough pieces are utilised for pit-props. The coppice wood of the ash is also a valuable commodity, its yielding nature making it peculiarly suitable for crate-making, and for this purpose larger quantities are consumed, and commands for it a remunerative price. It also commands the highest rates for poles in hop-growing districts, and is largely grown in the south for this purpose.

In the manufacture of ash less skill is necessary for the utilisation of the whole tree, and, with the exception of the cutting out of felloes and handles, the exercise of great ingenuity is not required, as is the case in the conversion of the oak.

Turning to the elm, we have two kinds to deal with, viz., the

English and Wych, which resemble each other in some degree. They have several of the characteristics of the ash, being tough and durable, and are more easily bent. The chief purposes to which elm wood is put are naves and felloes for wheels, the manufacture of which, being already described in reference to ash, does not require repetition. The elm is largely converted into boards for packing cases, large quantities being merely sawn from all sizes of trees into the required thickness, without regard to width. The larger trees of clean and good quality are frequently cut on the quarter for coffin-making—elm-wood displaying a peculiar figure, which when polished presents a beautiful appearance, and when washed over with a chemical mixture, as is sometimes done, very much resembles mahogany, and is in this way often passed off for that wood. In the cutting up of straight well-grown trees into boards for packing cases, the yield considerably exceeds the quarter girth measurement of the rough tree, so that the cost of sawing may almost be reckoned as compensated for in this way.

In the preparation of naves, the general custom is to crosscut the tree to the desired lengths, which vary from 15 to 18 inches, and from 8 to 15 inches in diameter. A large hole is then bored to extract the heart, which prevents the probability of the nave cracking while undergoing the process of seasoning, which is necessary before going into the turner's hands. The warping nature of elm prevents its use to any great extent either in the cabinet or coach-building industries. Shipbuilders continue to consume large quantities in a variety of sizes—for ships rails, 9 inches by 3 inches and upwards; covering boards, 12 inches by 4 inches and upwards; and catheads, which are short, run up to 12 inches square. Crooked elm is not common, as in oak and ash, but what is produced is converted into waterways for ships, which must have the natural and well-grown bend, and their scarcity makes this class of wood much sought after. The tops and very rough pieces go for pit-props. The elm is not a favourite wood with the turner, its warping and twisting nature being highly objectionable, and for cleaving it is absolutely useless.

The sycamore, or plane tree, promises to become extinct, from the large demand and the enormously increasing price obtainable for it. The supply is far short of meeting the industrial requirements, and the annual imports of inferior American timber of this kind is of necessity increasing. The large clean butts are almost exclusively made into rollers for calico manufacturers, and are generally from 18 inches diameter upwards. The pleasant appearance of the wood, with its clear white colour, makes it peculiarly suitable for mangle rollers and other purposes for contact with cloth, and the bulk of the ordinary-sized trees of about 12 inches are converted into these commodities. With reasonable care and management there requires to be not a particle of waste in its manufacture. The larger sizes of rollers taken out, leaves the odd pieces no less valuable than in the tree—brush backs, ornaments, domestic utensils, and numerous small ware being regularly made from this wood. The cabinetmaker consumes a considerable quantity of medium-sized wood for panels and furnishings of furniture, and, being susceptible of a fine polish, it is highly esteemed in this department of industry. Shipbuilders make extensive use of the sycamore for blockmaking, from 3 inches square up to a foot. In manufacturing sycamore, the greatest care is necessary in the seasoning of it, the wood being specially liable to draw damp, which immediately begins to stain and deteriorate its value to a serious extent. Exposed to wet, it decays and rots in a short time. The tops and branches of the sycamore have a greater value than any other wood for turning purposes, the smallest size, down to 2 inches, being equally useful for bobbins, etc., to the larger waste. As will be seen, there is little difficulty in converting this wood, and little or no ingenuity required.

The manufacture of the larch presents very little difficulty, being generally straight and regularly grown. The importance of this tree in the industrial world goes on increasing every year, and notwithstanding the large supplies available in the country, the demand keeps more than pace with them.

The railway requirements form the chief outlet for this wood. Sleepers consume immense quantities, the common size of which are 9 feet by 10 inches by 5 inches, and 9 feet by 9 inches by 4½ inches. The sawing of these being conducted on a large scale, special appliances are used for the saving of labour, and sawmill machinery is specially constructed for this class of work. In cutting out these sizes from the full tree, considerable sized slabs are produced, which are converted chiefly into pit-sleepers, which run from 6 inches by 4 inches down to 2 inches by 2½ inches. For lining railway waggons larch planks are the favourite wood, as no other can compete with it for toughness. It is necessary to select large timber for planks, as they are generally required in long lengths, 12 feet and upwards, the thickness being from 1 inch up to $2\frac{1}{2}$ inches, and from 6 inches broad upwards. In cutting out long planks, the tapering nature of the tree necessarily produces heavy slabs, which are converted into fencing. Where odd or short lengths are not of much consideration, they are always available for pit-sleepers, the demand for which is continuous. Light railway waggon framing is sometimes cut from larch instead of the oak, but it is necessarily of a light and small kind, as larch is unable to withstand the rough usage to which heavy waggons are subjected. Wheelwrights frequently use larch for cart shafts, and for cart lining it is highly popular.

The most valuable wood is used for boat-building, and the slight bend generally found at the base of the larch adds to its value for this purpose, being found suitable for the general shape of fishing boats and the curves round their stems and sterns. The full tree is planked with the bend in various thicknesses, from three-eighths of an inch up to 2 inches, and is usually done by vertical saws. The tapering in the width of the tree is no loss or objection, so that more than the quarter girth measurement of the tree is produced by conversion. The larch is also in great request for purposes where the round wood is used whole, such as telegraph poles and pit-wood.

In referring to Scotch fir and spruce, it is needless to say that their chief use is for boarding, and railway and pit sleepers, and the small wood for pit-props, so that little experience is necessary in the manufacture of any item connected with them.

In referring to beech wood, the remarks made on sycamore apply very much to it. The large and clean butts are made into rollers for calico manufacturers. It is also much used in the tool-making trade, and engineers use a small quantity. The bulk of the rougher and smaller wood is utilised for bobbins, and brushmaking forms a large outlet for the same description. It is one of the most difficult woods to cut up, its clinging nature necessitating more than ordinary power on the saw to drive it through. Cabinet work takes a share of good timber for chairmaking. The grain of the beech when sawn on the quarter is very brilliant, and displays a pleasant picture in ornamental furniture.

The alder and birch still maintain their old position in the clog trade, in which their wood is almost exclusively used.

The foregoing are the staple woods of home production used for general industrial purposes. The uses of other woods, such as chestnut, lime, walnut, poplar, and willow, have been of recent years quite revolutionised, and render their conversion for manufacturing purposes of little importance.

Notwithstanding the changed condition of our industrial wants, it will be seen that such timber as the oak, ash, sycamore, larch, and fir maintain an increasing usefulness, demonstrating the necessity of a greater development in the cultivation of our vast areas of waste lands to meet the growing demands of industry, and conserving to the nation as much as possible the wealth of which it is capable of producing.

ABSTRACT of ACCOUNTS of the ROYAL SCOTTISH ARBORICULTURAL SOCIETY for YEAR Ending 31st DECEMBER 1890.

CHARGE.

Balance from last Account :—		
Cash in Bank,	£22 16 0	
Cash in hand,	5 19 3	
		£28 15 3
Outstanding Subscriptions at 31st December 1889,	£111 11 0	
Less—Written off as irrecoverable, on account of Non-payment, Resignations, want of knowledge of Addresses of Members, and Deaths,	18 18 0	
		92 13 0
I. Subscriptions for current year, payable	£140 15 4	
Less—Paid in 1889,	3 5 6	
		137 9 10
II. Subscriptions payable in 1891 paid in 1890,		5 16 6
III. Subscriptions from re-instated Members not included in Charge,		1 4 0
IV. Subscriptions, Life Members,		26 5 0
V. Sum received in payment of Advertisements, and Sale of *Transactions*,		18 4 10
VI. Donations to "Illustration Fund,"		2 11 0
		£312 19 5

DISCHARGE.

I. Accounts paid :—		
Printing, Stationery, Prizes, Office Rent, Postages, etc.,		£110 11 5
II. Secretary's Salary and Expenses,		31 0 0
Balance :—		
Arrears of Subscriptions Outstanding,	£65 19 0	
1890 Subscriptions Outstanding,	68 5 4	
		134 4 4
Cash in Bank,	£4 7 11	
*Cash in Treasurer's hands,	32 15 9	
		37 3 8
		£312 19 5

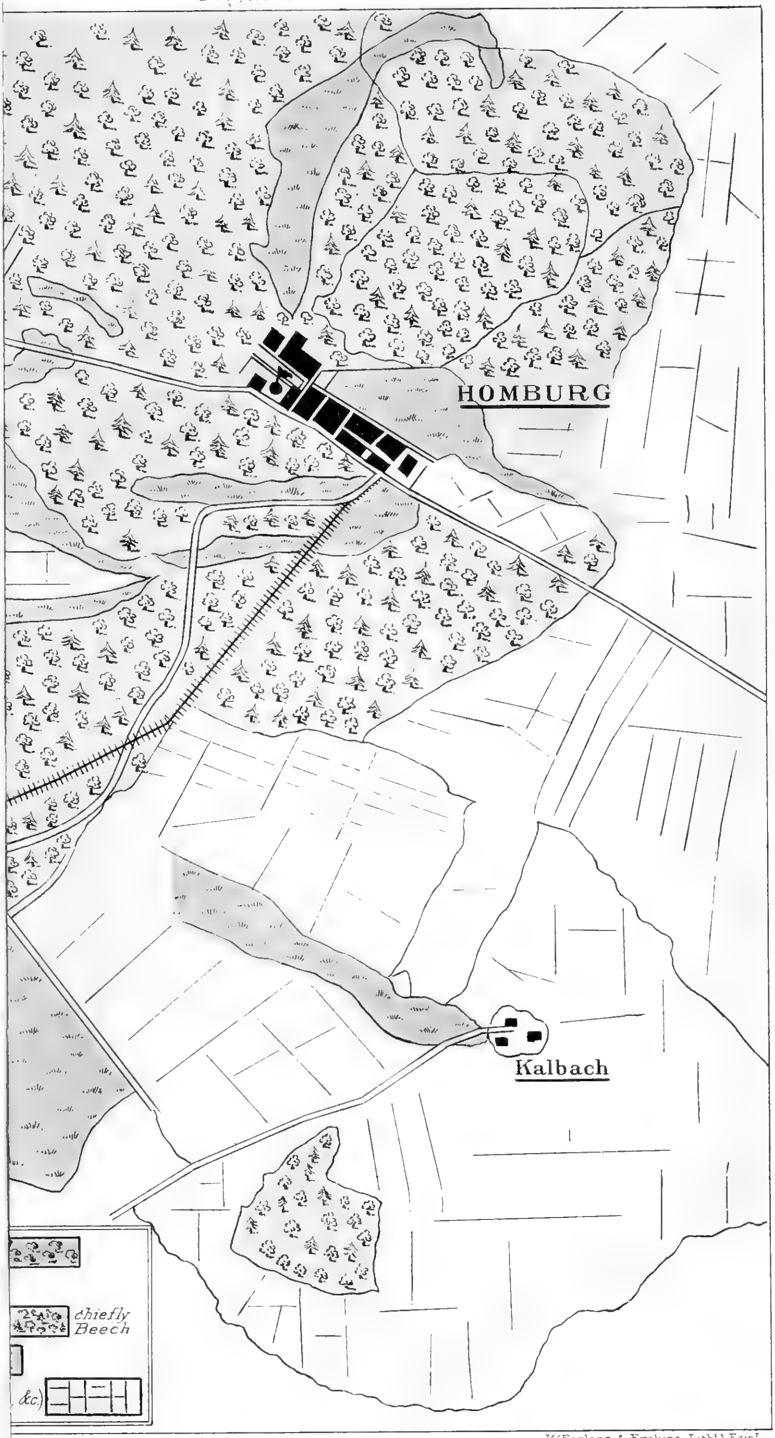
* Of this amount, a sum of £24, 1s. 1d. is retained, to meet Accounts applicable to current year, but not rendered at 31st December 1890.

NOTE showing Income, abstracted from foregoing :—

Arrears of Subscriptions payable,	£92 13 0	
Current Year's Subscriptions payable,	137 9 10	
	£230 2 10	
Outstanding at end of Year, *see* Discharge,	134 4 4	
Difference, being amount of Cash received,		£95 18 6
1891 Subscriptions paid in 1890,		5 16 6
Life Members' Subscriptions,		26 5 0
Advertisements and Sale of *Transactions*,		18 4 10
Donations,		2 11 0
		£148 15 10

Edinburgh, 10*th January* 1891.—I have examined the above Statement, and have compared it with the vouchers and other instructions produced to me, and find the Account accurately stated and sufficiently vouched; the balance in hands of the Treasurer is Thirty-two pounds fifteen shillings and ninepence sterling (£32, 15s. 9d.). The Nett Funds of the Society as at 31st December 1890 amount to One hundred and fifty-five pounds and twopence sterling.

JOHN ORD MACKENZIE, *Auditor.*



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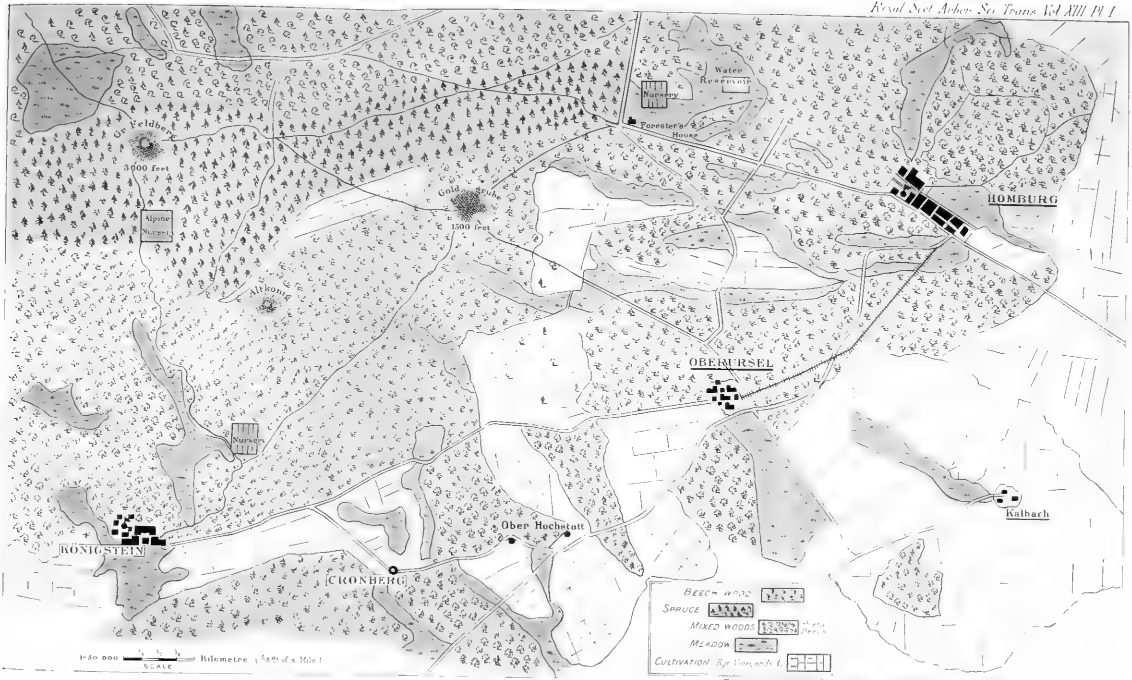

THE TAUNUS MOUNTAINS OF NASSAU

ADVERTISEMENTS.

TRANSACTIONS

OF THE

ROYAL
SCOTTISH ARBORICULTURAL SOCIETY.

VOL. XIII.—PART II.

SECRETARY AND TREASURER,

WILLIAM J. MOFFAT,

FELLOW OF THE BOTANICAL SOCIETY, EDINBURGH.

EDINBURGH:
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MDCCCXCII.

CONTENTS.

The Society, as a body, is not to be considered responsible for any statements or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XI. *Address delivered at the Thirty-eighth Annual Meeting, 4th August* 1891. By Isaac Bayley Balfour, Sc.D., M.D., F.R.S., Queen's Botanist in Scotland, Professor of Botany in the University of Edinburgh, and Keeper of the Royal Botanic Garden.

Our annual meeting, of which we to-day inaugurate the thirty-eighth, affords us the only opportunity which as a Society we have of reviewing our position with reference to the aims for the attainment of which we were incorporated, of considering how far we have progressed towards an immediate goal, and of discussing the lines along which we may hope to make further advance in the near future; and it has appeared to me, therefore, that it would be fitting were I from this chair on this occasion to say something regarding matters which have very particularly engrossed the attention of the Representative Council of the Society during the past year, and which it is certain will demand even more attention during the forthcoming one.

Into any retrospect of the work of a Society such as ours, there must always enter an element of sadness. As one anniversary after another comes round, and we measure our progress, we are conscious of gaps in the ranks of our comrades in work. Some veterans, or it may be youthful members, are no longer here to answer to the roll-call. And amongst those whom we miss at this annual meeting is one, the doyen of Scottish foresters, by whose death the Society has lost one of its oldest and most valued members. It is difficult to estimate the services which Mr William M'Corquodale rendered to forestry and to this Society. His reputation was not Scottish only, it was world-wide, and the woods under his charge at Scone had become the Mecca of those who desired to witness good forestry in this country. An original member of our Society, it may be truly said that to his indomitable perseverance and determination we owe it that the Society lived through those early years after birth which are fatal to many like institutions. The presentation made to him in 1878, which will be in the recollection of most of those present here to-day, and his election as an honorary member of our Society, illustrate the high estimation in which he was held by his fellow-workers; the pages of our publications will witness to posterity his energy in behalf of, and his interest in, the progress of our Society and of forestry, and generations yet unborn will appreciate his skill and foresight as a practical forester. He has gone from us in the fulness of years, leaving a record of a life well and usefully spent, and the stamp thereof on the forestry of his time. If I content myself with this brief tribute, and do not refer to particulars of his life and work, it is not because I do not think I might have usefully dwelt on these, but because I think that some pen better qualified than mine may well recount the story of his life, for incorporation in the publications of our Society, as one eminently calculated to be a stimulating example to younger men.

I must not omit to notice also that in Mr John M'Laren this Society has lost another veteran member, who did it yeoman service in its early days as an office-bearer, and died in office as a councillor.

In such men as these the Society loses those whom it can ill spare, and their removal should remind the younger men of the Society that upon them is now coming the burden of the work so well carried on by the preceding generation. May they acquit themselves as well.

I congratulate myself, in addressing the Society to-day, that I am able to speak in the hope that, within a very short period from now, the Society will have secured another and most important position, for which it has so long striven in its fight for the cause of forestry. I think all of you will agree with me that at no preceding time within recollection has the subject of forestry been so prominently before the public of the United Kingdom as it is at the present moment, and that not as a mere matter for discussion and talk—the time for that is past. Forestry is now within the range of practical politics, and something must shortly be done which shall give the means for ensuring the permanent and progressive improvement of wood-cultivation in this country. That this is so must be a source of peculiar satisfaction to the members of this Society, which for now thirty-eight years has been crying out, unfortunately for long in unsympathetic ears, the need there is for more attention to scientific principle in the method too frequently in operation in dealing with our woods. And more than this, our Society may fairly claim that not only has it been pointing out during all these years that there is room for improvement in forestry practice, and doing what it could to give effect to its teaching, but it has also from the first perceived that the real way to secure the betterment that is desirable is by giving to those who are to have the care and management of woodlands a knowledge of the scientific principles that underlie their work; and has advocated the establishment of a school for forestry teaching. It is, I think, not uninteresting to trace the successive steps by which the persistent efforts of our Society has enabled it to approach the goal to which it has been pushing, and which, shall I say, is all but attained to.

When the Society was founded but little general interest was taken in forestry, and in the first years of its existence it had much to do to furnish evidence of the need for its creation. These were, however, the days of inflated land-values and prosperous trade, and no indication of the depression shortly to set in warned proprietors of woodlands that ere many years the neglected trees would have to be looked to as carefully as the annual crops as a source of revenue. Gradually, however, the Society gained the confidence and interest of working foresters, and it is one of the features of the Society that it has been essentially a Society of practical men. The practical foresters of the country have been its backbone, and when the object is achieved which we all look for in the immediate future, and a Forestry School is established, it will be remembered that its institution eventuated from the efforts of practical men to obtain that education which would enable them to better their practice.

With its strong following of foresters, the Society prospered, stimulating by its prizes intellectual effort on the part of its members, and all the while crying out for means of education in forestry. It was not, however, until it had reached the appropriate period of its life—its majority—that the Society saw a definite step taken towards the furnishing of the much-needed forestry teaching—the acquisition of Inverleith Grounds by the Town Council of Edinburgh and by the Crown to form an arboretum of the Royal Botanic Garden, and to be used for scientific instruction. In the negotiations which led to this purchase, the influence of the Society made itself felt.

It is now some years since the Arboretum was acquired, and some, I know, have been inclined to question whether it has fulfilled the object for which it was secured. Well, to them and to you I would say that, if as yet everything that the more sanguine expected has not come about, the institution of the Arboretum has already given considerable impetus to the cause of forestry. It has acted as a centre upon which ideas of progress could focus, and, as I shall presently point out more fully, it is destined, I hope, to satisfy in the near future the claims, in respect of teaching, which the most enthusiastic of us could urge.

Following upon the establishment of the Arboretum, which had set people talking of forestry in a way they had not previously thought of doing, the Society made another important move in promoting the Forestry Exhibition—an exhibition which opened the eyes of many people to the interests involved in forestry. Unfortunately, the financial result did not provide a surplus sufficient for the object the Society had in view when it entered on so large an undertaking—viz., the endowment of a system of forestry teaching in Edinburgh. But although the hopes that had been formed in this respect were not realised, the exhibition contributed largely to the advancement of interest in forestry questions, and strengthened the Society for its further efforts to obtain what it had so long sought after.

Soon thereafter there came to the Society an honour, a not unmerited one—its Royal Charter. I need hardly say we are all proud of the distinction, and we are glad of it alike because it set a seal of approval upon the work done by the Society in the past, and because it gives greater weight to the endeavours of the Society in the future.

I have singled out these three events in the past of the Society as worthy of special notice, and you will, I believe, share with me the opinion that they, each of them, fix important positions in our march onwards in the cause of forestry. And during all this time, what of interest in forestry elsewhere? In our own town the Highland and Agricultural Society had been endeavouring to rouse interest in forestry by granting diplomas after examination, and proposals had been made for teaching in this country of the young foresters for the Indian Government; but otherwise I am not aware that any society or body of individuals was interesting itself in forestry. But the effect of the work of our Society was making itself felt elsewhere, and the appointment of the Select Committee on Forestry of 1885 may, I believe, be traced to our efforts. You all know what are the proposals of that Committee. After hearing of a great deal of conflicting evidence, the Committee devised a scheme which, if carried out in all its details, would have gone far to supply what we, as a Society, have been seeking for. But, alas! five years are elapsed since the recommendations of the report appeared, and there is no sign of any action being taken on the lines laid down, and it appears as if the only result of the Forestry Committee, so far as we are concerned, will have been the temporary cessation of effort to establish independent teaching of forestry in Edinburgh in expectation of the advantages which it was hoped the deliberations of the Committee would confer.

We were in this state of expectancy in 1889, when a new impetus was given to our energies by the arrival of Dr Somerville, fresh from the training he had enjoyed under the master of German scientific forestry, Professor Hartig of Munich. From the moment of his advent we have, I may say, felt that our hopes of the establishment of forestry teaching were near realisation. In Dr Somerville we had just the man required—one devoted to his subject, with full knowledge of it, ready and competent to impart his knowledge. And here you will allow me, whilst congratulating him on his election to the important and prominent position he now occupies, to express our sense of the great loss we have sustained in his migration to Newcastle. We all know how generously, for small pecuniary return, he worked for forestry in Edinburgh, and we recognise that it is a misfortune there was not, and is not yet, a post with sufficient remuneration attached to it to keep so good a man in Edinburgh. Let us hope that ere long conditions will be altered, and that we may yet see so admirably qualified a man as he occupying a chair of forestry in our university.

The cause of forestry has benefited to a very great extent by the two short years in which Dr Somerville has worked amongst us. For so good a man there was no difficulty in instituting in the university a lectureship in forestry, and under this appointment Dr Somerville delivered complete course of lectures on forestry during the winters of 1889-90 and 1890-91. These were open to any student in the university, and I believe I am right in saying that they were the first courses of the kind delivered in the United Kingdom, and that Edinburgh has thus given the lead in forestry teaching. Dr Somerville's work was in the main a labour of love: the fees provided a mere pittance, which of itself could not support a lecturer, and our Society therefore applied to the then recently established Board of Agriculture for a subvention under section 2 of the Board of Agriculture Act, 1889, in aid of the lecturer. Its application was successful, to the extent that in each of the years the lecturer received £100 out of Government funds.

Dr Somerville's labours did not, however, end with the opening up to students of the university of an avenue to a knowledge of forestry. They went further. The members of the Society will recollect that a circular sent to them last year informed them that a short course of lectures on botany and forestry for practical foresters would be given by Dr Somerville, and by the Keeper of the Royal Botanic Garden, during the winter months in the Botanic Garden. The course was opened, and twenty-two working-men were enrolled in the class—sufficient evidence, were it required, that lectures of the kind, if regularly and systematically supplied, would be greatly appreciated by a large body of men.

In these ways, then, after so many years of struggling, the Society has seen, thanks in large measure to its efforts, the initiation of a system of forestry teaching, and the beginning, shall I say, of a forestry school. This is matter for hearty congratulation. The movements, so far as they have gone, can only be regarded as initial. I hope and believe that they mark the beginning of what is to be a permanent and flourishing forestry school. But, if this is to be so, effort is still wanting. I have endeavoured in outline to point out to you how our progress has been a gradual one, slow at times, but persistent, until, as it appears to me, we are near the goal towards which we have been striving for so long, the foundation of a forestry school. How then are we to proceed? How are we to pass beyond initiation to settled permanency?

It is fortunate we no longer require to adopt the militant attitude in respect of the claims of our subject. The importance of forestry is now recognised in the country, and it is unnecessary nowadays to reiterate arguments in support of what is an accepted belief. What we have now to do is to induce those whose interest it is to encourage and foster good forestry to give practical support to the schemes by which alone it is possible to secure it. Circumstances have in a measure settled the lines upon which we must work, and the drift of events has cleared away many of the difficulties which up to a comparatively recent period beset the question of procedure. I think I shall carry you with me when I say that we must utilise, so far as may be possible, existing institutions for forestry teaching, and that our endeavour should be to graft any scheme of teaching we may consider adequate upon establishments already engaged in or adapted to cognate work. And this being so, I will go further and say that, so far as Scotland is concerned, there is now no doubt but that Edinburgh must be the seat for the first foundation on enduring lines of forestry teaching. Schemes for the creation of a forest school in a district more surrounded by forest land than is Edinburgh are very inviting on paper, but the carrying out of any one such as has been proposed would involve a maximum of cost; and it is open, I think, to question whether the special advantages claimed for a school in such a site would compensate for the great additional outlay that would be incurred compared with that required by an adequate scheme in a university town such as Edinburgh. What we have to aim at in our scheme of forestry education is the inculcation of the scientific principles underlying forestry practice, illustrated by reference to practical operations. In a country such as ours, without large State forests, it is not possible to contemplate, in the meantime at least, a system of official practical training such as is compulsory on the State forester on the continent of Europe. For practical experience our men, of whatever class, must, as now, undergo apprenticeship to, or work with, men capable of instructing them in their art. But what we want to do is to raise the practice of forestry everywhere from the position of empirical routine, to have it practised as a science as well as an art.

In connection with our aim, it is necessary even now to emphasise the point, that in any complete scheme of forestry education there are two groups of men to be provided for, for their confusion has led to frequent misconception on the part of those professing interest in forestry.

There are in the first place proprietors, land agents, factors, and others of similar position, to whom a knowledge of forestry will be of immense assistance in the performance of their duties, but who will not look to forestry as in any sense a profession, and with them may be classed those who propose to enter the forest service of the State in its higher grades in India and the colonies, and who will therefore make forestry a profession. To all these men an university education is essential. And then there is the practical forester—the man who, unless in exceptional circumstances, cannot look to the advantages of an university education, yet whose training is a matter of national importance, as upon his skill depends the proper management of our woods and plantations. The subjects of study involved in the education of both sets of men are the same, but under existing conditions combination of their teaching is an impossibility.

The practical point that comes up then for settlement is, how can we in Edinburgh provide for the teaching of all these men?

In the university here, a student can already obtain instruction in some degree in all the sciences underlying forestry practice, and the institution of lectures on forestry has furnished opportunity for his learning their application to the practical management of woods. But a fortuitous attendance on science classes, without prospect of the application of a university test and the award of a mark of university training, does not meet the requirements of our time. What we desire is that forestry shall be recognised in the university as an applied science, on equal footing with engineering and agriculture, and that so important a subject shall not be left to the care of an unpaid lecturer—we could not always hope to have so unselfish a devotee as Dr Somerville to occupy the position—but that, like the other subjects I have mentioned, it shall be entrusted to a professor occupying a distinct Chair of Forestry. As you are aware, this matter has been brought before the Universities Commissioners. How far they will be disposed to recognise the claims of forestry, and assent to its introduction in a curriculum of study, we are not able yet to say; but of this we may be assured, that the Universities Commissioners will not be prepared to provide all the money for the foundation of a chair of forestry. To this end, therefore, our energies must be directed. Already steps have been taken, not only by this Society but also by the Highland and Agricultural Society, with the purpose of raising a sum for the endowment of a chair. I see that the secretary will, at a later period of this meeting, give you some account of what has been done, and what has to be done, in this matter, and I shall not, therefore, say more regarding it now. I would only point out the considerable sum already promised gives us hope of ultimate success. It is well that it should be known that the grant of £100 by the Board of Agriculture to the university lecturer during the past two years, has been only a temporary one, pending the result of our own efforts and the action of the Universities Commissioners. Whatever the latter may be, it seems to me that what we have already done affords evidence of the interest that is taken in forestry here, and should convince the Board of Agriculture that our local effort is deserving of further and greater support from it. With the foundation of a chair of forestry in the university, and the institution of lectureships on plant-pathology and on plant-physiology, desired by the university as auxiliary to the chair of botany, we should have in Edinburgh a fairly efficient equipment for teaching the principles of forestry to those desirous of an university education.

But this university teaching does not give us all we want. There is still the question of instruction for practical foresters, and in considering how this is to be secured, we are confronted with a difficulty which has always appeared an obstacle in the way of their education—that, namely, of the maintenance of the forester during the period of instruction, apart altogether from the cost of the education itself. No doubt, were such education for foresters available, there would be found employers who would consider the sum needed to educate and support their foresters an investment good enough to justify them in making it, and large-minded benefactors might establish bursaries, through which foresters might be enabled to gain the advantage of the instruction offered to them. But these possibilities are not sufficient basis for the building up of a regular system of forestry teaching, and I am justified, I think, in saying that no scheme of education for practical foresters can hope for success unless it ensures at the same time that the forester shall be able to have sufficient for his support during the time of pupilage. Can this be accomplished in Edinburgh? I believe it to be possible by utilising the Royal Botanic Garden, and I shall now describe a scheme I have submitted to my Department, by which the difficulties referred to may be overcome. I start with the assumption that the subjects of elementary scentific education, with which it is desirable every practical forester should have some acquaintance, are these:—chemistry, physics, meteorology, geology, surveying and mensuration, entomology, botany, forestry, and horticulture; and I propose that courses of lectures on these subjects should be given in the garden in the evenings, under a curriculum extending over from two to three years, the subjects being arranged so that no more than two lectures would be given in any one week. The subjects taught would, of course, be illustrated practically so far as possible. Foresters desiring to attend the course of study prescribed would be enrolled as workmen in the garden, and would receive the usual weekly wage, and they would pass regularly through the curriculum of study, receiving the education free of charge. Of course they would have to take their part in all the work of the garden as do our employees at present. At the end of the curriculum the forester would leave the service of the garden, receiving when deserved a certificate of proficiency. It would be possible, of course, to receive only a limited number of men as garden-pupils of this kind, but others might be admitted to the advantages of the course under suitable arrangements.

I have referred in the briefest manner to the proposals I have made, but you will see that the gist of the whole scheme is that, whilst the forester gives his labour, which will be paid for at the normal rate, he will receive education in the scientific principles of his work, free of charge to himself. The scheme is one that could be carried into effect at a very small annual expenditure. The existing equipment for teaching at the garden furnishes most of what is required in this respect. The payment of the lecturers would be the chief item of expense, and for the amount required, not more than £150 per annum, I look to Government, and have reason to be hopeful for the success of the application that has been made.

In placing these proposals before this assembly of practical men, I venture to think that they are of a nature which will commend themselves to them, and that if carried into effect they will solve in a satisfactory manner the question of the education of the practical forester in the scientific principles of his work. They will not replace his practical training as a forester—I beg of you to remember that—for actual experience in the management of woods he will have as heretofore to learn under an expert forester.

Were such a scheme inaugurated, we should have the Botanic

Garden and Arboretum at last established as a centre of forestry teaching, and realising the expectations formulated now many years ago of their possible future. In conjunction with the work carried on in the University, the development of teaching such as I have sketched at the Botanic Garden, would complete the Edinburgh Forestry School, the creation of which would be a lasting monument to the determination and indomitable perseverance of the members of this Society—the practical foresters of Scotland.

Gentlemen, I have endeavoured to lead up by reference to the past of this Society to the position it occupies at present with reference to the question of the development of forestry in this country. I trust I have made clear to you that whilst we may congratulate ourselves on what has been done in the past, and may look hopefully to the future, yet our hopefulness must rest on our determination to succeed in what we have set our hands to do. Because we are so near the attainment of what we have worked for so long, we must not allow our efforts to relax, but rather with redoubled energy continue our struggle, with the intent that before another anniversary meeting comes round we may possibly crown our work of thirty-nine years with the success it deserves.

XII. *Introduction to Course of Forestry Lectures, Edinburgh University, Session* 1891-92. By Colonel Bailey, R.E., University Lecturer; Conservator of Forests, and Director of the Indian Forest School; formerly Acting Inspector-General of Forests to the Government of India.

In early times the greater part of the dry land was no doubt covered with trees and shrubs of various kinds, each kind flourishing and maintaining itself in the locality best suited to its special requirements. As the older trees fell to the ground, their places were taken by others of the same or of associated species, which grew up in the openings thus afforded to them, and an unbroken succession of trees and shrubs was in this manner maintained; for at that remote period but few of those destructive agencies were at work which have raised Forestry to a science, and have led to its inclusion among the subjects to be taught at this University.

What is the foremost among these destructive agencies? Unquestionably Man; and had we foresters lived in the days when his energies in this direction were most actively employed, and had we endeavoured to arrest the havoc he was committing among his natural forests, we should have found him a very difficult being to deal with.

It is no doubt true that natural phenomena, such as storms of wind, have always occurred from time to time; but the forest growth would, in most cases, surely if slowly re-establish itself after each visitation, and the damage done by four-footed animals, insects, and noxious plants, such as fungi, would not be likely to make much impression on the vast extent of forest which then covered the earth's surface. The human population of the world was small, and the requirements of man were by no means so varied and extensive as they are at present. But as population increased and civilisation advanced, the older order of things gradually and of necessity passed away; man had to extend the small patches of cultivation which were the scene of his first efforts in the art of agriculture, and he wanted timber and firewood for domestic use. He also needed grazing grounds for his flocks and herds, and much ground was permanently cleared of forest in order to satisfy his ever-growing requirements of this nature. Then in course of time he began to build better houses with larger timber; he made boats and ships; and, later on, he constructed railways, and developed numerous industries which consumed vast quantities of wood of all species, qualities, and sizes; at the same time he largely extended his cultivation and increased his flocks and herds; and before every one of these advances, portions of the natural forest went down, and disappeared for ever from the face of the land. But the process was a very gradual one, extending over many centuries. It proceeded slowly at first, and not until comparatively recent times did the country begin to assume its present appearance. It is not so very long ago that the road from London to Edinburgh was an unsafe one to travel over, in consequence of the gangs of robbers who found shelter in the thick forests through which it passed. I have no figures before me from which I can trace the progress of denudation; but I have no doubt that a marked change commenced from the time that these islands began to enter upon that marvellous development of their trades and industries, which has placed the British race in the foremost place among the nations of the world. Do not misunderstand me to pretend that these were changes for the worse; you do not require me to tell you that up to a certain, and, indeed, a very advanced point, they were very much for the better.

Long before this stage of development had been reached, however, a time had come when it was found impossible for every one to continue to help himself with a free hand; claims to ownership of forest and waste lands had been set up, and established by the law of Might, and some sort of restrictions had begun to be enforced. But these were quite inadequate to arrest the progress of the destruction of the natural forest, which at length reached a point at which the supply of forest produce became insufficient to meet the requirements of the population; and measures then began to be taken not only to secure some tracts of forest from further encroachment, but also to increase the wood-bearing area by sowing and planting. But it is not to measures of this nature that many of our largest forests owe their existence at the present day. Their continued maintenance is due rather to the protection they received under strict laws for the preservation of game, than to any endeavour to guard them for the sake of the timber they could yield. The New Forest in Hampshire is a good example of this, and the same may probably be said of the Windsor Forest, and of the Forest of Dean in Gloucestershire, as well as of others in Scotland.

It will easily be understood that the countries in which civilisation advanced with the most rapid strides were those from which the natural forests disappeared the soonest; and at the present time these islands have a smaller percentage of wood-producing area than is found in any other European country, with the solitary exception of Denmark. The actual proportion is as follows:—

Russia, .	. 40	per cent.	Greece, .	. 14	per cent.
Sweden, .	. 34	,,	Spain, .	. 7	,,
Norway, .	. 29½	,,	Belgium,.	. 7	,,
Germany,	. 26	,,	Holland,.	. 7	,,
Turkey, .	. 22	,,	Portugal,	. 5	,,
Switzerland,	. 18	,,	British Isles,	. 4	,,
France, .	. 17	,,	Denmark,	. 3½	,,

The average is 29½ per cent., and includes orchards and isolated trees in parks, hedgerows, and elsewhere.

Countries which, like ours, have a very small wooded area of their own, have to supplement their home-grown supplies of wood from other countries which are still able to produce more of this commodity than their population can consume; and, on reference to Dr Schlich's *Manual of Forestry* [which I shall very often have occasion to refer to, and on the general lines of which I propose to direct this course of lectures], I find that the United Kingdom annually imports—

Timber to the value of about . . .	£15,000,000
Minor forest produce to the value of about	£8,000,000
Total, about	£23,000,000

These facts have not, up to the present time, led to any very great amount of inconvenience. *Firstly*, because our insular position affords us great facilities for the importation of timber; *secondly*, because we have a plentiful supply of coal; *thirdly*, because our climate does not demand modifications of the nature which extensive forests are able to effect, nor do we, as a rule, suffer from any deficiency of the water-supply in our wells, springs, and streams; and *fourthly*, the geological formation and the configuration of these islands, and the climatic conditions under which we live, do not render it as necessary as it is in many other countries, that large areas should receive the protection against the effects of violent and continuous falls of rain, which is so well afforded by a crop of trees and shrubs.

It is true that a part of Scotland has recently suffered severely from floods; a large number of bridges have been broken down, railway embankments and roads have been damaged, large stretches of agricultural land have been denuded of soil, and potatoe and turnip crops have been washed away; felled timber has also been swept off, and along the courses of all the rivers from Perthshire to Ross-shire more or less damage has been done. The country between Edinburgh and Hawick, and especially about Galashiels, suffered severely last autumn, as we all know. These floods constitute a serious calamity; but I am not at present prepared to offer an opinion on the difficult problem whether it would pay to regulate them by means of planting up the hill-sides, or by constructing engineering works. I believe that calamities of this nature are, fortunately, of comparatively rare occurrence. Such matters are always difficult to deal with otherwise than by State intervention, because it often happens that the seat of the evil lies within the property of one set of proprietors, while its effects are felt most severely on the property of others.

The effects of the Scottish floods, however, bear no comparison with those produced by denudation in some other parts of the world, where the rain is heavier, the sun hotter, and the rock and soil are less consistent than with us.

Whilst employed by the Secretary of State for India at the French Forest School at Nancy, I visited the southern French Alps, which have been subjected to excessive grazing, and from many parts of which not only the trees and shrubs, but even the very grass has disappeared. The surface is therefore no longer bound together by roots; and when the heavy semi-tropical rain falls directly upon it, the soil, and subsequently the loose rock, slip down into the valley below. The water charged with these substances runs off with great rapidity, and suddenly fills the torrent beds. These latter soon become deepened by the "scour," when their sides, deprived of support, fall in; and the effect of this action, going on throughout the whole system of watercourses which traverse the mountain sides, is that, over enormous areas, the upper strata of the soil, with its fields, houses, and even villages, are borne down into the valleys, and the whole region, which presents to the eye little but a series of unstable slopes of black marl, has an extremely desolate appearance. But the damage does not stop here; for the débris is carried down to the comparatively level valleys and open country below, where it is deposited over fields, roads, railways, and villages, thus doing an enormous amount of harm.

In order to mitigate these terrible evils, the French government has undertaken the vast enterprise of regulating the torrent beds by means of engineering works, and of afforesting the mountain slopes over an area of more than a thousand square miles, including nearly two thousand linear miles of torrent beds. The cost of such an undertaking is of course very great, but the circumstances warrant the expenditure. I had an opportunity of studying these works for a fortnight in company with M. Demontsey, Inspector-general in charge of them.

A very similar condition of things prevails in the Hoshiarpur district of the Punjab, on which I had a short time ago to submit a report to the government of that Indian province. I have conversed with men who remember this range of hills covered with trees and tall grass, which were the home of the tiger and other wild animals; but now there is hardly a blade of grass to be seen, and the hills are gradually being washed away and deposited on the plains below. I am told that the bed of the Mississippi is being blocked by sand and soil brought down from the mountains of the "Far West" in consequence of the extensive clearings that have been made there during recent years.

I have not now time to speak longer on these very interesting questions, but hope to be able to treat of them in more detail in subsequent lectures, as well as to give some account of the works undertaken by the French government in Gascony, to arrest the progress of the dunes or moving sandhills of the west coast, which I had an opportunity of studying a few years ago.

But although the absence of sufficient home-grown produce has not hitherto caused much inconvenience, there is no doubt that, as time goes on, we shall have to go farther and farther afield for our supplies of timber; and that, partly owing to increased local demand in the foreign countries whence we have been accustomed to draw them, and partly to the productive power of the forests having become impaired by over-cutting and other injurious treatment, our importations from several of the most important of those countries are falling off; and it may be safely predicted that these supplies will, in course of time, considerably decrease, and that the price of imported timber will rise in a corresponding degree. We may, of course, eventually be able to bring to market the produce of even the most inaccessible forests of the Dark Continent to supply our ever-increasing needs; but it must be said that our future supplies are by no means secured, and that the time has arrived at which it has become our duty to take stock of the situation, and to consider what can advantageously be done to increase the timber production of our islands, so that we may be in a better position than we now are to meet, as far as possible, any interruption in the steady current of our importations which might occur owing to a partial failure of our foreign sources of supply, to the outbreak of war, or otherwise.

Dr Schlich estimates that we might be able to grow at home £13,000,000 worth out of the £23,000,000 worth of forest produce we import annually; and the forests created with this main object would give employment to a very large number of labourers, and would at the same time serve to protect agricultural crops from the effects of injurious winds, and to afford shelter to cattle and useful species of birds.

The desired increase in the amount of home-grown timber might be obtained by taking measures—*Firstly*, to obtain from our existing woodlands the maximum quantity of the best kind of produce that the soil is capable of yielding; and *secondly*, to increase the wooded area by planting and sowing up such portions of our waste lands as cannot be more profitably utilised. It must be confessed that to accomplish either of these things is not an easy matter in many parts of the kingdom, because, while some existing woods are maintained principally on account of their picturesque beauty, a much larger number are kept up as game preserves, and their proprietors have no wish that they should be treated with a view to obtain from them their maximum yield of wood. Again, vast areas of ground in Scotland are kept under heather as grouse moors and so-called deer "forests" (which have hardly a tree upon them), and these are greatly valued for the sport which, in their present condition, they afford, so that their owners do not desire to convert them into forests of trees. But in spite of these disadvantages, the area of woodland now available for systematic treatment is very considerable; and it might certainly be largely increased with great advantage to the proprietors of the land, as well as to the country at large, not only on account of the increased production of forest produce, but also by reason of the larger employment of labour, that would follow a movement to extend the forests. The following sentences are taken from a recent article in the *Times* newspaper on "Men and Deer in Scotland":—"Deer forests by no means bring their owners the large rentals popularly supposed. The famous Blackmount Forest does not yield, it would appear from the Crown agent's figures, 6d. an acre. The group of forests in Inverness-shire, belonging to Mrs Chisholm, is let at about 3d. an acre. Even 1d. an acre is not an unknown rate. In Sutherlandshire sporting rents seem to be, on the whole, higher than elsewhere. But 1s. an acre would appear to be quite unusual; and we have no reason to think, notwithstanding the popularity of deer-stalking and the growth of wealth, that rents will improve. Many Highland proprietors let their shootings as regularly as they let their farms, and these are not times in which they are likely to turn a deaf ear to people who say, with any show of good sense, 'I can tell you how to make more out of your estate than by afforesting it.'"

It is not necessary for me to say that "afforestation," in the sense in which it is here used, is the exact opposite of the kind of afforestation that we are assembled here to study; and how such a misleading term as "forest" came to be applied to a tract of land which is devoid, or almost devoid, of trees, and on which it is not intended to promote the growth of trees, I cannot explain.[1] If the figures given in the *Times* are anything like correct, the rate per acre derivable from a deer forest cannot be called high. The average profit on the whole of the French forests, taken together, was, for the three years immediately preceding 1886, about 7s. an acre. But of course the really important point is the rate of interest on their capital value, which shootings and forests respectively yield. Dr Schlich, basing his calculation on Weise's *Yield Tables for the Scots Pine*, concludes that land which cannot be let for the raising of field crops, for shooting or other purposes, at a minimum rental of $2\frac{1}{2}$ per cent. on the value of the land, may with advantage be planted up with Scotch pine or other similarly remunerative tree; and I fancy that, even after excluding bare upper ranges, which it would not pay to deal with, a good

[1] I have since been told that the ground is supposed to carry a "forest" of antlers!

deal of land in Scotland would be found to fall within this definition.

It is said that an additional area of six million acres of forest might produce the whole of the timber (excluding mahogany, teak, and fancy woods) that we now import; and we have nearly 27 million acres of waste lands in the British Isles, of which about 13¾ millions, or one-half, are in Scotland. The question is one with which I am not yet in a position to deal at all fully; but it is evident that even if the establishment of additional forests on a large scale in the near future be unlikely, it is not too soon to exercise forethought in the matter of our timber supply, and to endeavour to arrive at some safe conclusion as to what measures might most advantageously be taken to secure it. I may, however, say that it appears, from the agricultural returns of 1891, that while the area of corn-growing land in Great Britain has considerably decreased, the area of woods and plantations has increased by nearly 100,000 acres in the last three years, and the increase would probably have been larger had not the rating of woodlands to some extent discouraged it. In Scotland the greatest increase has been in the counties of Aberdeen, Inverness, Ross and Cromarty. Forests are not so exhausting to the soil as agricultural crops; for in the case of the latter the entire plant, except the roots, which are sometimes also taken, is removed; whereas in the case of a crop of trees, the leaves, flowers, and fruit, which are far richer in nutritive elements than the wood, are annually returned to the soil, and thus serve to maintain its productive power, as well as, by their protective action, to keep it in a good physical condition. Hence forests can flourish on comparatively poor soil; some kinds of trees, notably most of the conifers, including the Scots pine, being able to grow on ground that would be quite incapable of producing a series of remunerative agricultural crops. It is therefore, generally speaking, not necessary to select rich fertile soils for the raising of forests, which ought rather to be established and maintained on ground which cannot be profitably cultivated. Scotland has a large extent of land of this kind, which could be planted up without detriment to the sporting interests; and there seems no reason why this country should not be able to produce as fine and valuable timber as is obtained from the shores of the Baltic and from other parts of Northern Europe. There is, then, plenty of work before Scottish foresters, both in the way of making the most of existing woodlands and of planting up new areas; and the object of the present course of lectures is to impart to the younger aspirants after fame in this direction some of the leading principles that should guide their endeavours.

It seems, at first sight, marvellous that the United Kingdom should, until very recently, have been without the means of imparting any regular instruction in this important science; but the fact appears less remarkable when we consider how far cultivated land and pasture have with us taken the place of forest, the large extent to which we have drawn our supplies of timber from abroad, and the comparatively small amount of wood we consume as fuel. There is, however, no doubt another reason why progress in this direction has been so long delayed, and that is the very small area of forest land in these islands which is owned by the State. In countries where extensive forests are State property, forest schools were long ago established. I will instance the case of France, with the forests of which country I am better acquainted than I am with those of any other. The forests of France are thus owned:—

	Sq. miles.		
By the State, ...	3,734	= 10·7	per cent.
,, communes or parishes, and public institutions under State control,	8,073	= 22·7	,,
,, private proprietors, ...	23,657	= 66·6	,,
Total, ...	35,464		

Although the State and the communes or parishes together possess only about one-third of the total forest area, the extent of their property is very large, amounting in all to 11,807 square miles. To carry on the management of these large domains, the State maintains a body of highly skilled foresters, who, before their appointment, have received two years' training at the National Forest School at Nancy, at which institution, until a few years ago, candidates for the Indian Forest Service also received their professional education. But it is a remarkable fact, that although private proprietors own no less than 23,657 square miles of forest, or double the amount owned by the State and the parishes together, there is not a single private forest school or class throughout the country; and further than this, although the lectures at the State Forest School are open to the public, advantage is very rarely taken of this privilege by private proprietors. This fact is doubtless due in a large measure to the succession laws of France, which tend to form very small properties; but there are still many large properties with valuable forests upon them; and the explanation of the abstention of private proprietors from any attempt to avail themselves of the means of instruction in Forestry which are afforded to them and to their wood-managers is said to be that, as the State forests and the officials in charge of them are scattered about the country, the art of forest management is more or less popularly known; that private owners have before them the State forests, which serve as models for the management of their own timber estates; and that they can get a certain amount of advice and assistance from State officials, who are occasionally permitted to render aid in this way. But in many localities the private woods are too distant from State or parish forests to permit of their owners obtaining any assistance from the government officials; and they are then thrown entirely on their own resources, with the result that although, speaking generally, the principal private forests are well managed, mistakes, and grave ones, are frequently made.

I may perhaps here mention that in France private proprietors cannot clear any wooded area without notifying their intention to do so at least four months beforehand; and the government officials can, with certain exceptions, successfully oppose the clearance, if the continued maintenance of the wood is considered advisable on any of the following grounds, viz.:—

1. To protect mountain slopes.
2. To protect the soil from erosion, and to hinder encroachments by rivers, streams, or torrents.
3. To preserve springs and watercourses.
4. To protect coasts against erosion by the sea, and against the encroachments of moving sand.
5. For the defence of the national frontier.
6. For sanitary reasons.

But although private proprietors in our country are not subjected to any such interference with the disposal of their property, they have none of the advantages which the existence of extensive State forests, and the presence among them of State forest officials, gives to private proprietors in France; and in these islands the science of Forestry is almost unknown outside a small circle of professional men, who, to their credit be it spoken, have acquired the valuable practical knowledge they possess without any of the advantages afforded by a previous study of the principles evolved by experience in countries where systematic forest management has been long practised.

But, in spite of these disadvantages, Scotland can show numerous well-managed forest estates—such, for example, as those of the Duke of Athole, of the Earls of Mansfield and Seafield, of Lord Lovat, and of other proprietors who might be mentioned; and it is universally admitted that the art of raising nursery plants, of establishing plantations, and of rearing park trees is here carried out with a success unsurpassed by the foresters of any other country. Our Forest Class has thus the great advantage that excellent practical instruction in work of this kind can conveniently be given to it.

It is impossible to mention the Duke of Athole's forests without alluding to the loss we have recently sustained by the death of Mr John Macgregor, a representative Scottish forester, who has done much to forward the progress of Forestry in this country, and whose well-known figure will be missed from among us for many a year to come.

But I believe I am justified in saying that certain branches of the science have unavoidably received less attention than is desirable. I allude principally to regeneration by natural means (*i.e.*, felling in such a manner that the old trees may be caused to produce their successors in the form of self-sown seedlings), and to the preparation of working plans or schemes of management, by means of which continuity in the system of treatment is secured, the forest is made to yield the maximum quantity of the most paying kind of produce, and provision is made for the removal of a regular annual or other periodical yield; at the same time the owner is enabled to realise the full yield with confidence, and his forest is secured against damage by over-felling.

But if insufficient attention has hitherto been paid to these questions, the reason is to be found in the entire absence of means of acquiring a sound knowledge of the principles on which they should be treated, and of the way in which these principles should be put into practice. And here I am afraid I must admit that we are placed at a disadvantage, in that we shall find it difficult, if not impossible, to give our students practical instruction in forests where the principles of scientific Forestry have guided the management for a sufficiently long time to enable us to point to the results they lead to. The life of a tree extends over a long period of years, and the effects of a system of management cannot be fully studied in any forest until that system has been in force throughout at least one life-period of the principal species of which the forest is composed. As a rule, it is only in forests owned by the State that studies of this kind can be carried on to the best advantage, for such forests alone are free from liability to deviation from the plan of management, due either to the varying fortunes of a succession of owners, or to changes of policy which each owner in his turn has full power to introduce.

The only important State forests in the British Isles are situated in the south of England. I understand that 800 acres of Windsor Forest have recently been made over for management to the authorities of the Indian College at Cooper's Hill, and this tract will, in course of time, become a most valuable field of instruction; but I believe that nothing has yet been done towards framing working plans for the New Forest or the Forest of Dean.

Unfortunately all of these forests lie at such a distance from Edinburgh that I fear we cannot avail ourselves of them very often. The students of the Indian College spend one college term in visiting and studying, under Sir Dietrich Brandis, selected State forests in Germany; but I am afraid such distant excursions are beyond our reach, and we must rely for practical instruction on such woodlands, comparatively near at hand, as the courtesy of their owners and foresters may enable us to visit. It may eventually be possible to effect some arrangement similar to that recently made at Cooper's Hill, and to place some conveniently situated woods at the disposal of the University Professor for the instruction of the students in Sylviculture and other branches of Forestry; but this cannot be done at present.

I will now bring these introductory remarks to a close; but before proceeding to enter upon the detailed study of my subject, I will indicate what the Course would have been had I been able to commence it in October. I should then have taken up the several branches in the following order, viz.:—

1. Utility of Forests.
2. Sylviculture, or the Culture of Trees when growing together and forming Woods or Forests.
3. Mensuration.
4. Valuation of Woods.
5. Working Plans or Schemes of Management.

The time before me this year is very short, and I am afraid to make promises as to what I shall get through ; but I hope very much to be able to complete a condensed course down to the end of Sylviculture.

I hope also to arrange excursions on Saturday mornings to woods in the neighbourhood, varied by visits to the Arboretum, the Royal Botanic Garden, and the Museum of Science and Art, which contains a valuable collection of wood specimens and other objects of interest to foresters.

I feel greatly encouraged by the comparatively large attendance of students to-day. I hope the numbers may be not only maintained but increased, and that in the course of time we may be able to attract surveyors, land agents, and landowners from this as well as from other parts of the United Kingdom.

It may perhaps not be out of place if I say, in conclusion, that I am sure the departure of Dr Somerville, my predecessor, and the first lecturer on Forestry at this University, is much regretted. I can only hope that I may prove as successful an instructor as he was.

XIII. *Management of Scots Fir Forests in North Germany.*

By A. C. Forbes, Farnham Royal, Slough, Bucks.

The following outline of the management of Scots fir forests is based upon personal observations made in the districts between Berlin and the towns of Stettin and Stralsund, on the northern coast-line; and although the area embraced is comparatively small when compared with that of which it forms a part, yet it contains one of the most richly wooded districts of the whole of North Germany; and, so far as soil, climate, and geographical features are concerned, may be said to be perfectly representative of the region occupied by Scots fir in the north of Prussia.

The general aspect of this part of the German empire cannot be called particularly picturesque, as no lofty mountain ranges stand out in bold relief against the sky, or form a pleasing background to the landscape, but still it cannot be termed monotonous in any sense. The surface is generally undulating, with large tracts of perfectly level, marshy land occurring frequently, and usually in conjunction with extensive lakes, some of which almost attain to the dimensions of inland seas. The geological formation belongs to the Post-Tertiary, forming a surface soil of white, fine, diluvial sand, almost entirely free from stones, beneath which lie extensive beds of marl and clay, and which account for the prevalence of the lakes. The rivers are not particularly numerous, but are all navigable for small craft for a considerable distance inland, and are connected by numerous canals.

One of the greatest industries in a small way appears to be brick-making, for which the clay-beds provide abundant material, while extensive saw-mills exist in the vicinity of the water-ways. The land is entirely devoted to agriculture or forestry, the nature of the soil causing one or the other to predominate, according as it is good or bad; and the character of the ground can be pretty accurately surmised by the way in which it is utilised, totally waste ground being rarely met with. This probably accounts for the somewhat irregular distribution of the forest land over the whole area, many large tracts of country being almost treeless (with the exception of road-side trees), while others again are almost entirely covered with timber, shelter belts or small plantations being rarely seen. The practice of planting the road-sides with fruit or other broad-leaved trees is very common, and renders travelling in hot weather less fatiguing than it would otherwise be.

Although the Scots fir predominates largely over all other timber species, yet many extensive tracts are covered with beech, oak, and other hardwoods, wherever the soil is suitable for their growth. Spruce is the only other conifer in any quantity, silver fir or larch being rarely met with. The marshy land is principally occupied by birch, alder, or osiers, the latter being extensively cultivated along the banks of the Elbe, near Hamburg. The area occupied by the hardwoods is gradually increasing, owing to the practice of undersowing the fir with beech or hornbeam, which, in certain cases, afterwards takes the place of the fir, although it is doubtful if the change is of great advantage from a financial point of view, except under the most favourable circumstances.

On the poorer soils the Scots fir is grown entirely pure, and on these it forms unbroken masses many thousands of acres in extent, small patches of birch, alder, or willow in the boggy places being the only variation met with. Travelling through these extensive forests proves very monotonous, and a pleasant relief is experienced when one passes into a part stocked with hardwoods, or a mixture of fir and beech. The surface is principally covered with a thick grassy vegetation, heather existing in comparatively small patches only, although it probably formed the principal vegetation at one time. The bilberry (*V. myrtillus*) is also very abundant, and many other plants associated with dry sandy soils. Patches of a large coarse grass (*Calamagrostis epigeios*) are common, and it appears to be a suitable grass for fixing loose sand. Owing to this surface vegetation, natural regeneration is impossible on a large scale, although small patches may be seen here and there in thin places, and where the ground has been broken up by the extraction of roots, or other causes. In many cases, however, after clear fellings, and where the surface has been well stirred and broken, there appears to be no reason why it should not prove successful; but, as re-sowing is more certain, and can be done at a small cost, the latter method is always adopted for restocking purposes. The game existing in these forests is principally represented by roe-deer, which are very numerous; red deer, wild swine, and hares being also present in smaller numbers, while rabbits are comparatively scarce.

In addition to the State forests, which constitute the main mass, every town and village possesses its forest of several hundreds or thousands of acres, as the case may be. Common rights to the pasturage, dead wood, and litter exist in regard to these forests, and the miserable appearance presented by the portions so exposed, provides ample proof of the importance of forest litter in the early stages of a plantation's growth.

The rotations adopted in the State forests for the Scots fir vary with soil and situation, from sixty years on the worst, to one hundred and forty years on the best localities, one hundred years being perhaps the most common. Fellings on the even ground, where the soil is pretty uniform, are made in long narrow strips, which run along the whole length or breadth of the compartment, and are about 50 yards in width, the length of the compartment varying from 600 to 800 yards, or rather metres, and usually having a quadrangular form. The cutting is usually commenced at the side of the strip, and the trees thrown with their crowns pointing away from the centre of it, so that the brushwood, etc., does not interfere with the throwers. The trees are cut about 6 inches above the surface of the ground, no chipping round being done or required, as "toes" are seldom seen. The saw is put through as far as possible, a wedge driven into the cut, and the rest of the work done with the axe in a rough and ready style. Although the workmen appear to be less neat and expert with the axe than is the case with the British woodmen, they are very expert in taking out trees without injuring surrounding young wood in any way, although the thin crowns possessed by most of the trees render this less difficult than in the case of rough timber. The trees are cross-cut at various diameters, according to the class into which the timber is placed, while the tops and all branches up to 2 inches in diameter are sawn up into metre lengths, and stacked up into cords between posts, the larger pieces being split; the brushwood being stacked up also in the same way. All the trees and lots are numbered with an apparatus for the purpose, the former having the length and cubic contents also stamped on the butt end. The wood is sold by auction by the forest officials at some convenient inn; the number, size, and class of the tree or lot being called out by an assistant in place of a catalogue. The timber is sorted into five different classes, according to the cubic contents, all trees being included in the first class which contain over 70 feet (true contents); and those that contain less, or not more than 18 feet, going into the fifth class.

According to Schwappach,[1] the following prices are about an average for the several classes:—

[1] "Wachstum und Ertrag normaler Kiefernbestande, in der nord-deutschen Tiefebene." (Berlin, Julius Springe.) 1889.

Class I., 19 m. 6 pf.; II., 17 m. 6 pf.; III., 14 m. 6 pf.; IV., 12 m. 6 pf.; V., 10 m. 6 pf. per cubic metre (35 feet); or, when reduced to British equivalents—7d., 6¼d., 5d., 4½d., and 3¾d. per foot respectively. These figures are obtained after deducting felling expenses, so that the prices approximate closely to those obtained for Scots fir timber in Scotland, where the greatest number of the trees would probably come under Class III. (1 cubic metre, or Scot, 28 feet). The timber is usually removed from the ground where cut by the buyer, generally by means of small timber carriages. These are very light, and not much larger than a good-sized handcart, and are easily moved about by one man when unloaded. They consist of two wheels, with a short bar fixed to the axle, two of these carriages being required for each load. The method of loading them is rather ingenious, and is done with little expenditure of labour. It is accomplished by means of a large square wooden post, about 6 feet 6 inches in height, which is solid for about a foot from the top, and about the same distance from the ground. The remaining portion is divided in the centre by a slit about 3 inches wide, the two sides being perforated by a double row of holes for the reception of iron pins. This post is set up perpendicularly beside the tree to be loaded, and propped up by a long wooden pole, which fits into a notch at the top. A chain is passed round the tree at the point where the post is set up, and the end fixed into a hook attached to the end of a short handle about 4 feet long. On each side of the point at which the hook is attached are two grooves for fitting into the pins which go through the post. The end of the handle or lever being placed in the slit, the pins are placed beneath it as far up the post as the chain will permit. By now alternately raising and depressing the other end of the handle, and moving a pin up after each stroke, the end of the tree is gradually raised from the ground to the required height, and the carriage run beneath it. The tree is then lowered to the axle of the carriage, and made fast with a chain, and the other end raised in the same way. By these means a man can raise one end of a tree, 60 or 70 feet long, and containing 50 feet of timber, 5 or 6 feet from the ground, in about a minute after putting the post into position; and the whole tree can be loaded by two men in about ten minutes. Two stems usually form a load, one above and one slung below the axles, a couple of horses being yoked to the fore carriage, to which a pole is attached.

For removing the timber to the margins of the forests, tramways are sometimes used where the ground is sufficiently level for their proper working. One of these tramways used in the Eberswalde forest is of the following description. The rails are attached to small wooden sleepers, and are placed about 2 feet apart. These rails and sleepers are in sections 20 feet long, so that all that is necessary for their laying down, is to place the end of one section against that of another, the fore part of one rail fitting into the hinder part of its neighbour. Special sections are provided for sidings, so that the trucks can pass one another on the road. These trucks are made entirely of iron, and are about 4 feet in length, standing about 18 inches above the rails. Across the centre of the framework is an iron perforated bar, on the underside of which is a pin, which is let into the centre of the framework, so that it can revolve in any direction when going round curves, etc. This bar carries the timber, a pin on each side keeping it in position. In loading, the trees are simply rolled up long tressles on to the trucks, two of the latter, connected by a long pole, being required for a tree length. They are usually drawn by horse-power, although small locomotive engines can also be used on the tram-lines if required.

After the felling is completed, the roots are grubbed up, and as many as can be taken out without too much labour. This is done by clearing away the earth from the stump with the spade, and cutting the large roots, special appliances for lifting them out being in use. They are split, and stacked up in the same way as the other firewood, although they are principally turned into charcoal by the purchasers, which is made on the spot, every fragment of a root being collected and used up. The nature of the soil renders the extraction of the root much easier than is usually the case, so that the work is done without any loss, although the profit may not be great.

After all the work in connection with the felling and removal of the timber is completed, a trench is cut round the cleared area for the purpose of excluding the pine weevil and other injurious beetles which attack the young plants. This trench is about 6 inches wide, and about the same depth, with perfectly perpendicular sides. About every 12 yards deeper holes are taken out, into which the insects fall when travelling along the bottom of the trench, all attempts to scale the sides being quite unsuccessful if the trench has been properly cut. This precaution proves very effective, as may be seen from an inspection of one of these pit-falls, in which dozens of weevils and beetles of all kinds may be found, forming splendid depots for the entomologist. From these pits the beetles are either collected and destroyed, or remain there until they die from starvation.

The ground having been cleared of timber and roots during the course of the summer following the felling, it is re-sown or planted the following spring; usually in April. Sowing is by far the more common method of the two, planting being only resorted to for beating up and such-like purposes. For preparing the ground a forest plough is used, which has a broad flat sole and two large mould-boards, and makes a furrow about 2 inches deep and about 9 inches wide. The furrows are made about 4 feet apart, and as straight as any existing roots, stones, etc., will permit; the small surface roots of the former crop, however, being the only obstacles encountered on properly cleared ground. The head of the plough is attached to the axle of two wooden wheels, whereby the depth of the furrow is regulated. The seed having been dressed with red-lead to protect it from birds, is either sown by hand, or by means of the numerous seed barrows and machines for the purpose; the method adopted varying with the nature of the ground and other circumstances. On flat, fully cleared land, a seed-barrow is usually made use of, which deposits the seed in one or two drills; a small rake dragged in the rear covering it in. These machines are of various sizes, the larger requiring two men, and the smaller one man to work them. On average ground they can get over about an acre or more per hour, according to the width between the rows. For sowing rough ground a seed-box is sometimes used, which is a long narrow box about 4 feet in length, and about 3 inches broad and deep. This box is slung over the shoulder by a strap, and the seed ejected by working a spring at the bottom of the box. The most common method employed in rough ground, however, is hand-sowing, for which women are employed. The workers are divided into two squads, one sowing, and the other covering in the seed with rakes, the former carrying the seed in small earthenware jars. They are usually preceded by two men with a heavy narrow roller, on the face of which are ridges for the purpose of making small furrows for the reception of the seed; but where many small surface roots exist, the latter interfere greatly with its effectiveness.

The quantity of seed used is about 6 kilogrammes per hectare, or about 6 pounds per acre, which rarely proves too much by the time the young plants have gone through the critical periods of their early life. The greatest enemy that they have to contend with is probably the rough grass, which rapidly grows over the opened furrows, and often smothers up the seedlings before they can get their heads above it. To provide plants for beating up such places, small nurseries are usually established at the time of sowing by enclosing a small piece of ground with rough wooden hurdles, or a fence about 5 feet in height, so that deer, etc., are excluded. These fences are made from Scots fir thinnings, about 2 inches in diameter, with stronger poles for posts, and cost about 3d. per yard. If the nursery is likely to be required for several years, and serve for several successive fellings, a more durable fence of split fir poles of a larger diameter is erected, and costing about 5d. per yard. Branches of pine or spruce are interwoven through the lower bars to exclude hares and rabbits where they exist. The ground in these enclosures is trenched, and all roots and stones thrown out, and then sown with Scots fir or other species as required. The seed is generally sown here in shallow drills made by a kind of rake with broad thin iron teeth, which is drawn lightly over the surface. The seedlings are usually transplanted the first year, either into rows in the nursery or into the gaps in the re-sown area. For the former work an ingenious machine is sometimes used, which is well adapted for the light sandy soil. In appearance it resembles a small handcart without the body, the wheels and handle only being present. On the axle is a seat for the workman, who sits facing the handle, the latter being supported by a leg with a broad wooden foot. From the centre of the handle falls a short iron bar, on which is suspended a long horizontal iron rod, the extremities of which are bent down at right angles. On these two extremities are hung the handles of a broad species of scoop with a toothed cutting edge. The handles being suspended at a point about their centre, the ends are within a convenient distance of the workman, who, by lowering or raising them, can lift or dig the scoop into the ground with ease, while the soil can be drawn towards him or pushed in the opposite direction, by similarly working the handles. By this means he can take out a trench about 3 feet in length and about 6 inches deep, with a perfectly perpendicular side, in three or four strokes of the scoop. Two women are employed putting in the plants, which are placed on wooden bars of the same length as the trench. These bars have a toothed zinc edge, between the teeth of which the plants are hung, so that their tops are above and their roots below the edge. The bar is then placed on the edge of the trench, so that the roots hang down its perpendicular side, and the trench filled up by the machine. By drawing the bar carefully back the tops of the plants are released, and the work completed, the filling up of the trench having left the surface perfectly level. This machine gets over the ground more rapidly than the spade, but is only suitable for the very finest soils, free from stones and other obstacles. The cost of planting with this machine is reckoned to be about 3d. less per 1000 than by hand and spade.

Planting in the forest is done with a planting iron in the form of a wedge, a smaller wooden implement of the same shape being used for the seedlings. Three or four plants are usually put in on every square prepared patch, from which the grass has been removed by a kind of broad hoe, the corners of which are turned down. This hoe is a very handy implement for removing the turf, and is also used for clearing lines for sowing where the plough cannot be used. The larger plants (two years) are put in by women, a man preceding them and making the holes with the large iron, which the women fill in with the hand in the sandy ground. The seedlings are put in in the same way, except that the large implement is dispensed with, and the worker makes the holes and plants at the same time. Slit-planting seems to be never adopted, although pit-planting is practised in underplanting and similar cases. The cost of sowing a hectare in the manner described is about 40 marks, of which the ploughing costs 15 marks and the seed 18 marks, so that the labour does not come to much. Planting costs about 60 marks per hectare.

After the ground is once stocked with young plants, nothing more is done until the first thinning takes place, which is usually between the twenty-fifth and thirtieth year after sowing. If the latter has been a successful one, the young plants will not stand more than 3 or 4 inches apart in the rows at the age of four or five years, so that by the time of the first thinning the struggle for existence will have been a very severe one, and none but the stronger plants will have survived it. This thinning, however, is chiefly confined to the cutting out of dead wood and suppressed trees, and any dominant trees that stand immediately beside each other, so that it can hardly be termed thinning in the ordinary sense of the word. The larger trees at this age will not average more than 6 inches or 7 inches in diameter at the surface of the ground on soils of the best class, while the majority are below this size. Their height growth, however, is very marked, and is greater than is usually found in more freely thinned woods. During the next forty years the smaller suppressed trees are taken out from time to time, after which little is done until the end of the rotation. The first thinnings yield little but brushwood, and this is dragged out to the forest roads and lotted up in cords, the trees remaining as they were cut. The thinnings after this will be large enough for pit-props, or the smaller trees for poles which are sold entire, all wood not suitable for these purposes being cut up into firewood. After the sixtieth year or so small quantities of low-class timber will be produced, and the roots will be large enough for removal. About this time, too, the undersowing with beech or hornbeam occurs, which may either be done with the intention of changing the crop after the firs are removed, or for purposes in connection with soil preservation and fertility, wind breaks, filling up thin stockings, etc. This sowing is also done by women, who break the surface with a small hoe in patches about a yard or so apart, and sow about a dozen seeds in each patch. These trees thrive remarkably well under the shade of the firs after they once get a fair start, and exert a powerful influence on the soil fertility. If it be intended to change the crop from pine into beech forest, the pines are gradually thinned out as the hardwoods grow up, but if the conditions are not suitable for this, the latter get little consideration, and grow as they can until the end of the rotation, when they yield considerable quantities of firewood.

Constant watchfulness against insect ravages is necessary in these forests, especially in regard to the attacks of *Liparis monacha*, *Gastropacha pini*, etc., the caterpillars of which moths sometimes commit frightful devastations in the fir forests. Acres of forest may be frequently seen in which every tree has been ringed with a band of pitch for the purpose of preventing the caterpillars of the latter from ascending the trees, and the decaying remains of the creatures may be still seen sticking on the ring by the hundred, in company with many other beetles, etc., which had evidently been bent upon a similar errand. For the purpose of destroying the larvæ of cockchafers and other pests, swine are allowed to be herded in the forests in suitable places.

Although great quantities of the produce of the forests are consumed in the districts where grown, a large proportion is transferred to Stettin and other seaports for shipment, or to Berlin for home use. For this purpose, use is made of the numerous canals and rivers which intersect the country. All the unhewn timber is floated to its destination, while the sawn is placed on barges. The logs are made up into rafts, each raft consisting of about fifty stems, in eight sections, a section having six or seven logs abreast, which are kept together by a piece of wood nailed across the ends. The sections are attached to each other by willow or birch withes, which are fastened to a stout peg driven into the end of the stems. Three men will navigate a raft 250 or 300 feet in length, a horse usually assisting in towing on the canals. The men wear spikes strapped on to the bottoms of their boots to prevent them from slipping on the wet wood, and work the raft with long poles, with sharp hooks at the end for sticking into a stem when necessary. In going through the locks the sections must be disconnected, although the whole raft can be accommodated when they are abreast. The cost of this method of transport is reckoned at something like one farthing per ton per kilometre, or a little over $1\frac{1}{2}$d. per four miles.

All the principal saw-mills stand on the banks of these canals and rivers, and have large timber docks leading off the main stream for the reception of the timber. From these docks the wood is dragged out as required, by simply passing a chain round two or three stems, and connecting it with one from the machinery, which drags them up a sloping gangway to a cross-cutting machine. After being cross-cut they are rolled right and left on to timber stagings, thence they are taken up into the mill by a small trolley drawn by the machinery. The sawn wood is taken out at the opposite side of the mill, and stacked up into piles in the yard to remain until wanted. Tram-lines lead from these yards to the water's edge, where the deals, battens, etc., are loaded on the barges for further transit. Immense quantities of timber can be seen in the vicinity of these mills, wherever a wide part of the stream or natural lake offers facilities for being utilised as a depot; the grass and weeds growing on the rafts bearing testimony of a long sojourn in the water.

On drawing a comparison between the condition of the North German pine forests and that of Scots fir woods in Scotland, two main features strike one at once, and these are the crowded condition of the former during the earlier stages of growth, and the open and thin stocking in the later periods, being almost exactly the reverse of what is usually found in the case of the latter. In Scotland the custom prevails of thinning freely during the first thirty or forty years, and little or not at all afterwards, whereby every tree remaining at the end of that time has had every opportunity for full development. The German system, on the other hand, results in the survival of the fittest only, and gives no artificial aid to individual trees, but allows them to fight it out between them. Thus it is that the dominant and vigorous trees are the only survivors at the end of the rotation, and these, on an average, will not exceed 100 to 150 trees per acre at the end of 100 years, and the better the soil the smaller the number. A fully stocked acre of Scots fir in Scotland will often contain about double this number, or between 200 and 300 trees on soil of average quality, with an average volume of 25 cubic feet, or 5000 to 7000 cubic feet per acre. Schwappach, in the work already quoted, gives the following figures as the normal yield and dimensions of Scots fir in North Germany per acre:[1]—

SOIL I. QUALITY.

Main Crop.					Periodic Thinnings.	
Age.	No. of Trees.	Average Height.	Average Diameter, Breast Height.	True Cubic Contents	No. of Trees.	True Cubic Contents.
		Feet.	Inches.	Cubic Feet.		Cubic Feet.
20	1716	27	3·37	956	...	...
40	704	51	6·50	3572	1012	713
60	332	70	10·13	5457	372	1063
80	220	84	12·81	6831	111	1014
100	181	91	14·42	7760	39	729
120	155	102	15·83	8446	25	728
140	137	106	17·09	9046	18	493

These figures tend to show that the final felling is not so heavy as might be obtained by earlier thinning; but the total yield is probably as great, if not greater, than that obtained by the British system. By reckoning up the total yield of timber from an acre at the end of 100 years, we get 11,279 cubic feet from the best quality of forest land in North Germany, which is equivalent to 8984 cubic feet according to our system of measuring, assuming the latter to give 20 per cent. less than the true contents. The number of trees standing at the end of this period is 181, which have a total volume of 7760 cubic feet true measurement, or an average of 42 feet per

[1] The actual figures are in metres, cubic metres, etc., per hectare, but I have reduced them to British equivalents as near as possible.

tree. These 42 reduced by 20 per cent. are brought down to 34 cubic feet, so that the average size is rather greater than that assumed for Scottish timber of the same age, although the latter may be too lowly estimated. The fact must also be taken into account that the greater part of the earlier thinnings from the German woods are little but firewood, although the accumulating interest on the sums realised for the latter gives them considerable importance by the end of the rotation. Taking everything into consideration, it is probable that, after all, there is not so much difference between the total yields in both cases; but when quality is considered, the German timber would probably have the preference. The constant struggle which goes on during almost the whole period of growth causes a natural pruning of side branches to go on continually, so that it is rare to find a branch or large knot on the stems of the larger trees at a less height than 60 or 70 feet from the ground. The growth of the wood, too, is remarkably uniform, and eccentric wood-rings are rarely seen, even in the centre of the butt end. These two conditions are about all that are necessary for producing the best class of fir timber, and were the timber grown under the two methods in the same market, the German growth would undoubtedly fetch a higher price, as a rule, where quality and size were most in demand.

I have compared soils ranked as belonging to the first class, or best quality, in Germany with average plantation soils in Scotland, because I consider the latter to be superior to the former as a rule. In Germany only the worst description of soil is devoted to forestry, while in the lowlands of Scotland many plantations exist on soil that might be, and in many cases has been, devoted to agriculture, so that an average would probably be struck at about the same quality of soil in both cases. In regard to climate and elevation, the German woods probably have the best of it, in so far as their ultimate height growth is affected, but the difference is too slight to justify a proper comparison being made, as the length of the growing season makes less difference to the Scots fir than is the case with many trees.

Although this system of natural selection appears to give the best results on good soils, and where the trees are sufficiently vigorous to carry on a lengthened struggle, it is questionable if it is the best method of treatment on the inferior soils, where the trees can derive little nourishment from the ground. In such cases the retention of a certain proportion of branches is of much greater importance than where the trees are deriving a plentiful supply of mineral matter from the soil, because in the former case a larger proportion of water must be taken up in order to get an equivalent quantity of inorganic constituents, and consequently the former element must be again evaporated from the leaves. This necessitates a larger leaf surface and a freer circulation of air, which the crowded condition is not calculated to provide, and in consequence the vigour of the trees gradually declines, and their chances of development are small. This is more easily seen when the stocking of such ground is considered, and the large number of undersized trees which are present examined. It is then seen that the struggle for supremacy has not resulted in the survival of the fittest, but in the gradual weakening of the whole; and instead of the stronger trees making room for themselves by smothering their smaller neighbours, they have only been injured in the attempt. Schwappach gives 1600 trees per hectare as the average for soils of the fifth quality at the age of eighty years, which is equivalent to 647 per acre. The average diameter of these 647 is only $5\frac{1}{2}$ inches, and the height 35 feet, so that timber dimensions are not reached, and quality need not be considered, as in the case of the better qualities. Without actual proofs one cannot say whether such trees would have reached a much greater size had they been duly thinned or not, but there is every reason to suppose that want of space has had as much to do with their small size as inferiority of soil. Thinning is a subject upon which no two men can be found to agree in every detail, and in spite of all experiments, no hard and fast rules can be laid down for its guidance, so that it is possible for errors to be committed under the most careful and scientific management, although the general results may be good.

XIV. *On the Cedar of Lebanon, Cedrus Libani; syn. C. atlantica, and C. Deodara.* By Robert Hutchison of Carlowrie, F.R.S.E., University Club, Edinburgh.

Name of the Species.—(1) *Pinus Cedrus*, Linnæus; (2) *Cedrus Libani*, Barrelier. Linnæus having included pines, firs, larch, and cedars in one class, under the denomination *Pinus*, gave the designation of *Pinus Cedrus* to the Cedar of Lebanon; but I am surprised that some of those botanists who believed it better to divide these trees into several classes, should have included the Cedar of Lebanon among larch and fir: thus Tournefort, Duhamel, Miller, etc., class the cedar under the larch; Poiret, Loiseleur-Deslongchamps, Lindley, etc., under the fir. I think with Barrelier, A. Richard, and others, that it is preferable to make it a class by itself.

Sap and Leaves.—The Cedar of Lebanon has two flows of sap in a year, like the larch. The first begins early in May, and ends in July; the second begins about fifteen days after the first has stopped, and ends in September.

The leaves of the cedar are stiff, and of a deep green; they are, like those of the larch, disposed upon the tree in two different ways, one by one and in bunches. The first surround the shoots of the year, and the second spring from buds on wood of one year's growth, or from shoots on older wood which has borne leaves on preceding years.

Flowers and Cones.—The Cedar of Lebanon usually bears male and female flowers, but it will be seen from observations related further on, that some trees bear only male flowers and others female.

The male flowers are disposed in simple erect catkins, about $\frac{1}{4}$ inch in diameter at the base, when the flowers have attained their maturity. These catkins are produced on the upper surface of the branches, and have no resemblance to those of any other tree. The flowers which compose them are ripe in October, and are then of a pale yellow, and give off an abundance of yellow pollen dust.

The female flowers, disposed in simple catkins like those of the pines, are also stiff, and are egg-shaped and reddish; they ripen at the same time as the male flowers, and are transformed into cones shortly after being fecundated.

The cones of the cedar are egg-shaped, and are from 2 to 3 inches in length. The seed is furnished with a wing, and is of the same colour and size as that of the silver fir.

Fructification.—According to M. Louis Vilmorin, who has observed with much care the fructification of the Cedar of Lebanon, in the climate of Paris, the male and female flowers usually begin to appear in May, but it is necessary to examine them closely in order to distinguish them. The male flowers require for their growth till the end of September, or even the beginning of October, by which period they are perfectly distinct, and throw off a yellow powder. The female flowers require the same period for their growth, but are less visible because they are smaller, and they are transformed into cones after their fecundation. These cones begin to grow the following year when the sap rises. They are at first light green, then they assume a violet tint; they attain full size by the end of the autumn, and during the winter they acquire a brown-grey colour. The following year they remain upon the tree; and it is only during the months of February and March of the third year that the scales with the two seeds attached to each burst from the cones and fall to the ground. Thus, supposing that the cones are formed in December of the year of flowering, they will remain about twenty-seven months on the tree before the scales and seeds fall.

M. Duhamel de Fougeroux has, in the park of his chateau of Vrigny, near Pithiviers (Loiret), five cedars which were planted by his grand-uncle Duhamel-Dumonceau, one in 1757, the other four in 1770; and he has sent me the following observations which he made of the flowering and fructification of these cedars. The male flowers are observable towards the end of September, and they attain maturity and give off a yellow powder in October, by which time the female flowers are also distinguishable. The following year the cones attain to nearly their full size, and during the winter assume the brown colour which they retain. In the following July the seed has acquired its maturity, but it is very difficult to extract it from the cone. In the month of June or July following, that is, about the middle of their third year, the scales fall with the seeds, and in August there is nothing left but the bare stems of the cones on the branches, as in the silver firs. Thus the cones remain about thirty months on the tree from the time they are put forth till the scales and the seeds fall. If the cones are gathered a short time before the period when they should burst and the seeds fall, the scales can be detached from the stems with the utmost ease. The seeds, which are soft before they attain maturity, are almost as hard then as those of the silver fir, and they have begun to germinate. Thus on opening them the embryo is found nearly changed into a plantlet, and if it is put immediately into the ground it will spring up very quickly. This must be done, for after the process of germination has commenced, it would be impossible to preserve them till the following year. There springs up around the cedars at Vrigny many self-sown plants which perish, choked in the oak forest which surrounds the cedars, trampled under foot, or destroyed by other causes; nevertheless, after two or three years some are found big enough to be put into the nursery.

On August 12, 1844, I visited the Cedars of Lebanon in the beautiful garden of M. Guy, at St Germain-en-Laye (Seine and Oise), and I saw a great number of male flowers upon several of the cedars which stand isolated; these flowers, which wanted some weeks of attaining maturity, were upon the lowest branches. They were hard, conical, of a pale green, and the longest were about an inch in length. M. Guy told me that they would give off the pollen in the course of October, that it was very abundant, and of the colour of sulphur. I did not see the female flowers, which are much less numerous, and are usually produced on the branches towards the top of the tree, but they reach maturity at the same time as the male flowers with the pollen of which they are fecundated, and in a short time after they are transformed into cones. M. Guy told me that it is necessary to gather the cones in the spring of the second year, as the seed was then very good, and that the buyers would not have it from cones gathered later. If the cones remain upon the tree, the scales and seeds fall during the autumn of this year, or about twenty-four months from their first appearance.

The cedars in M. Guy's garden are twenty-two in number, and their age is about seventy years, all situated near the house, some in clumps, where they have grown close together, others standing alone upon the lawn, the latter producing the greater number of flowers and cones. I noticed upon some of the isolated cedars a great number of cones of the preceding year, which had attained to almost their full size, and which were of a dull white colour. Many of these cones were on the top of the principal tiers of branches, and so close that they almost touched one another. One of the cedars standing alone had been transplanted when about three feet in girth, from a grove which was being thinned. The transplanting did not appear to have hurt it, for it was as fine as those in its neighbourhood. M. Guy's cedars produce an abundant crop of self-sown seedlings on the walks, lawns, and borders, but they all seem to perish, crushed by feet, cut down by the scythe, or otherwise destroyed, so that none are found two years of age. I observed in the borders some seedlings that had sprung up some months before, and which were as fine as plants I had obtained from seed of the same year from the cones on the cedar in the Jardin des Plantes.

M. Pessin, head of the botanical school in the Jardin des Plantes at Paris, having observed in 1844 the dissemination of the seed of the Cedar of Lebanon in that garden, made a communication on the subject to the "Societé Royale et Centrale d'Agriculture." It appeared in the *Bulletin des Seances* of that Society, 20th March 1844, as follows:—"M. Pessin, corresponding member for the department of the Seine, sends some seeds of the Cedar of Lebanon gathered from the tree planted in 1735 in the Jardin de Roi by Bernard de Jussieu, which have germinated in the cones still adhering to the tree during this winter, and fell to the ground during the latter part of January. This germination, which is doubtless due to the mild and damp temperature of the winter, has been observed for the first time this year. Among the seeds already developed there are some whose stemlets are not less than half an inch in length. Several hundreds gathered in this state from the ground, and sown in February, have succeeded perfectly well." The natural seed-bed resulting from this dissemination of seed had given birth to a great number of plants, which I visited on the 29th of April 1844. They were growing under the shadow of the mother-tree, or quite near it, where the raking and the trampling of the work-people had probably killed them, for I could find none on the 25th of June in the same year. I have never observed nor heard of any other resinous tree producing a similar germination.

M. Renou, inspector of the Algerian forests, has published a "Notice sur les forets de Cedres de l'Algerie" in the *Annales forestieres* for the year 1844, page 1, from which I quote the following observations upon the flowers and cones of the two kinds of cedars noticed by him:—"The flowers of the two sexes appeared in September and October; in the following June the female ovaries presented already the appearance of a greenish cone of half an inch in length, and of an average diameter of one-third of an inch. These young cones are, so to speak, still in the herbaceous state, and they bend with the slightest pressure. By the month of July in the following year the cones have acquired a woody consistency, and enclose seeds of perfect maturity; but they do not begin to shed their seed till the autumn rains, and some cones retain their scales even till the end of winter."

My conclusion from these statements is—that the flowers of the Cedar of Lebanon usually ripen in the climate of Paris in the course of the month of October; that the cones remain twenty-four months upon the tree before they shed their scales and seeds; that the time at which the scales and seeds fall varies from the twenty-fourth to the thirtieth month, if the information which I have procured is correct; and lastly, that when the seed does not fall till after the winter, or till towards the end of a mild winter, it begins to sprout in the cones.

Loudon says (*Arboretum*, vol. iv., p. 2423) that the cones of the cedar do not attain maturity till the third autumn, and that they may be gathered and preserved for five or six years, without the seed being impaired. This last statement seems to me an error, if it refers to cones gathered shortly before the fall of the scales, and especially if they did not fall till after the winter, for then the seeds have already begun to undergo the process of germination; but if they have been gathered some months before this period, they will remain healthy in the cones for a longer or shorter time, which, however, I cannot indicate, even approximately. According to the same author (vol. iv., p. 2404), the cedar does not bear cones until it is twenty-five to thirty years old, and that the most of the seed then produced is barren; and that only from cones of older trees is fertile seed obtained. He says that some cedars bear only male flowers, others only female, but that some produce both, and these observations have been made on cedars more than one hundred years old. Thus some of these trees would have diœcious flowers. M. Renou has observed the same thing in the Algerian cedar forests, and has mentioned it in the paper already quoted. There are, says Loudon, in his *Arboretum*, vol. iv., p. 2404, "some cedars at Whitton and Pepperharrow, and in other places, which although more than one hundred years old, and in a vigorous condition, have scarcely yet borne male and female flowers."

Miller says that four cedars, which were planted in 1683, when they were 3 feet high, in the Botanic Gardens at Chelsea, and which are believed to have been among the first planted in England, "have produced during several years a great number of male flowers, but that three only have yielded cones, which only attained maturity after thirty-five years; that now (in 1766) the seeds which fall from the cones produce plants in abundance and without any care."

M. Vilmorin has, on his property of Verrieres, about fifteen miles from Paris, a cedar which began to produce male flowers at twenty-three years old, and cones at twenty-eight years. He says, "I have noticed in the park of Fromont that cedars about twenty-eight years old bore cones. I have a cedar which was planted in 1804 by my father, and which, as yet, has yielded no flowers. M. Gayau has some cedars thirty miles from here, which were planted in 1815, and which have not yet fruited. It is possible that these trees bear flowers and cones less regularly in France and England than in those countries to which they are indigenous."

Seeds and Natural Seed-bed.—I have already said that plants have been raised from the natural seed-beds round the cedar in the Jardin des Plantes, round the cedars at Vrigny, and round those in the garden of M. Guy. A friend tells me that he has remarked cedars at Marcigny (Saone and Loire), the property of M. Polissard, which yield an abundance of plants from the natural seed-bed, and that among these plants there are some already over six feet in height. M. Vilmorin, in a note on the *Traité Pratique de la Culture des Pins,* by Delamarre, page 319, says that he has seen a quantity of young plants spring up under the fine cedars in the park of Bellevue, near Meudon, and that a cedar planted by his father in a garden he had in Paris in the Faubourg Saint Antoine has also often produced young plants which were self-sown in the grove where it grew. It is probable then, that the cedar may be able to perpetuate itself in France by self-sown seeds as in its native country.

From what has been stated, there is not sufficient data to indicate the exact age at which the cedar begins to yield fertile seed to supply a natural seed-bed, but it can scarcely be before it is sixty years old. As to the proper age of cedars when the cones may be gathered for the seed, I think it would be prudent never to gather any from a tree less than sixty years old. We have seen that the seed in the cones is fertile in the spring of the second year; and it is from these, and even from younger cones, that the seed is oftenest gathered. Have these seeds then reached their full maturity? Some trustworthy experiments should be made to clear up this point. These experiments might simply consist of sowing in the same border seeds taken from cones gathered in the spring of the second year, and seeds from cones gathered from the same tree shortly before the seeds would have been shed naturally; and then to closely observe the growth of the trees produced from each sowing, in order to see if they were equally good and equally able to withstand the vicissitudes of the seasons. Until these experiments have been made, it is manifestly better not to gather the cones for the seed till just before the time when the scales with the seed would naturally fall to the ground. It is almost impossible to get from seed-shops any cones but those which have been gathered too soon, often much too soon, the scales of which adhere so firmly to the stem, that in order to extract the seed one has to use a centre-bit to pierce the cone close at the stem. M. L.-Deslongchamps advises to begin by sawing off six or eight lines from the bottom and as much from the top of the cones, these portions containing only abortive seeds; by this operation the extraction of the seed is rendered much more expeditious.

Mode of Vegetation and Dimensions.—The Cedar of Lebanon has a tap-root, and is very firmly rooted, otherwise it could not resist the wind, since its head is very wide-spreading when it stands alone. The trunk is straight, but when the tree stands alone it almost always divides at a greater or less distance from the ground into several branches, which usually assume the perpendicular soon after they leave the trunk. When the trunk rises to a greater height, it diminishes rapidly in diameter, because the tree is furnished with branches from the ground like the firs, and amongst the number there are always some very thick ones. The leader is at first very brittle, and generally leans to the north or east, but the following year it straightens itself.

The principal branches spread widely, and are covered on the upper side with thick foliage; they are palm-shaped, which gives the Cedar of Lebanon a remarkably majestic appearance, easily distinguishable at a distance. The bark is of a deep brown-grey colour, and furrowed rather than rugged.

The cedar grows well in a confined situation, where its trunk is straight and bare of branches; and it changes its appearance so much that it can scarcely be recognised, because, independently of the difference which exists in all trees grown in confinement and those grown in an open space, its leaves are not so closely huddled together upon the branches, and are of a much lighter green. The trunk of the cedar grown in a confined space appears to acquire a much greater bulk than the larch does, judging by what I have seen in the park of Fromont and in M. Guy's garden, the only places in France where I have found cedars grown in a confined space, and I compared them with larches similarly situated in my own park. "When cedars are grown in clumps," Loudon says, *Arboretum*, vol. iv., p. 2425, "either by themselves or mixed with other trees, they increase in size almost as rapidly as the larch or the silver fir when exposed to the same treatment; and perhaps it suffers no more than any other pine or fir from the loss of its side branches."

M. Renou says that in the forest of cedars situated near Blidah, there is a mixture of these trees, from those of a venerable age to plants of one year's growth, but in some portions the clumps are all of one age.

In the *Bulletin des Seances de la Societé Royale et Centrale d'Agriculture*, of the month of May 1844, there is a note about the cedars of Mount Ciga near Teniat-el-Haad, Algeria, addressed by the Minister of War to the President of the Society, in which it is stated "the cedars which grow upon the Djebel-Ciga are very abundant, and generally very large, but they are found of all ages. The cedar propagates itself by seed; this propagation is extremely easy, judging by the immense quantity of very young cedars with which the ground is covered; but these young trees are destroyed during the time of the great heat by the fire which the Arabs light in the forests. In those parts of the mountain which the fire has spared, the cedars, of from 15 to 20 feet in height, are so close together that there is difficulty in getting through. The cedars grow upon the northern slope of the mountain. The ground that they occupy forms a horizontal zone of from 600 to 700 yards in breadth by 4 leagues in length; this zone of ground is about 1200 feet above the level of the sea."

The Cedar of Lebanon can live for a long time upon high mountains without decaying, as it is nearly four hundred years since mention was first made by modern travellers of the cedars on Mount Lebanon; and these cedars, so remarkable on account of their great size, are still in vigorous health. It appears that the Cedar of Lebanon cannot survive so long in the plains of

Europe. The two cedars in the Chelsea Botanic Garden, which remain out of the four planted in 1683, are, says Loudon (*Arboretum*, vol. iv., p. 2406), in a state of decay, which shows that they had passed their maturity; but they are growing in a poor sandy soil, mixed with gravel, resting at 2 feet deep on a hard subsoil. The same author says (*Arboretum*, vol. i., p. 48) that there is at Enfield a cedar which was in a state of decay in 1821, and this cedar is only at the utmost as old as those at Chelsea. Amongst a great number of cedars planted in France in 1735, the same year in which was planted the one in the Jardin des Plantes, those growing in deep loam show no sign of decay.

The cedar acquires during its early years a larger girth of stem, but I do not believe that it attains to the same height as several firs and pines in Europe; and in support of this belief, I give the following measurements:—

Varennes de Fenille reports that the cedar in the Jardin des Plantes in 1786, that is to say, fifty-two years after it was planted, was 6 feet 7 inches in girth at 4 feet 6 inches from the ground. M. L.-Deslongchamps says that he measured this cedar in 1812 at the same height, and that it then girthed 8 feet 8 inches; in 1837 he measured it again, and found it 10 feet. I measured this tree on the 27th of May 1844, when it girthed 10 feet, having made no increase in the interval since 1837. I could not take its girth at the ground, because it was surrounded with a bank of stones, and its height was only 56 feet. I ought to mention that they had earthed up the base of the tree, an injurious practice which should be avoided, and in measuring the girth, allowance had to be made for the height above the primitive soil. The height of the tree would have been greater if its head had not been broken about fifty years before by a musket shot. The soil in which it grows is poor, and contains a great deal of plaster brought from the demolitions in Paris. Allowing it to be one hundred and fifteen years old in 1844, its leading shoot had made an annual growth of nearly 6 inches to that date.

The cedar at Vrigny, planted in 1757 by Duhamel-Dumonceau, was about eighty-four years old in 1844; and in the autumn of that year its diameter at 3 feet from the ground was 5 feet, its height was 80 feet, and the spread of its branches was 76 feet. At 13 feet from the ground it divides into several forks, but as one of these continues the trunk, the tree has a straight stem. The annual increase in bulk of this cedar, calculated by its diameter at 3 feet from the ground, has been one-sixth of an inch. Of the four cedars planted also at Vrigny by Duhamel-Dumonceau in 1770, the largest has a diameter of 3 feet 6 inches at 3 feet from the ground, it is 78 feet in height, and its trunk is straight to the very top. These trees are growing in a free and nourishing sandy soil, mixed with heath-mould.

There is in the kitchen garden at Vrigny a cedar which was raised in 1808 from the seed of the fine cedar just mentioned, and was thirty-seven years old in 1844; it had borne for several years male catkins, but it had not produced cones; it was 48 feet in height, and its diameter was 20 inches, and its annual increase till 1844 had been one-eighth of an inch.

Jaume Saint Hilaire has given, in the *Annales de l'Agriculture francaise* for 1841, p. 204, the girths of a Cedar of Lebanon planted in 1743 by Duhamel-Dumonceau on his estate of Denainvilliers, near Pithiviers (Loiret). These measurements were taken at 1 foot from the ground, at the following dates:—in 1753 it girthed 0·76 metre; in 1779, 1·86 m.; in 1786, 2·03 m.; in 1799, 2·35 m.; in 1809, 2·65 m.; in 1822, 3·14 m.; in 1831, 3·44 m.; in 1835, 3·50 m. It is easy to calculate the annual increase of this cedar at these different dates, supposing it was six or eight years old when it was planted.

There is, in the district of Courteilles, in the garden of M. A. Richard, a cedar which in 1843 was about fifty-one years old. I found its diameter then to be 2 feet 8 inches, and its height 53 feet; its trunk was divided at 7 feet 6 inches from the ground into five large branches, almost vertical at their junction. The annual increase of this tree had been up to 1843 one-seventh of an inch.

Delamarre says, in the second edition of his *Traité Pratique des Pins*, that the three largest cedars in France are the cedar in the Jardin des Plantes, the cedar at Vrigny, and the cedar at Montigny-Laucoup, Provins (Seine and Marne), planted by Duhamel in the garden of M. de Trudaine. I have given the dimensions of the two first of these trees. Delamarre says that the last was then (1827) 13 feet 2 inches in girth at 4 feet 6 inches from the ground. M. L.-Deslongchamps speaks of the same tree in his *Histoire du Cedre du Liban*, and says that it required four people to clasp it with their arms; consequently the girth cannot be less than 20 feet. This cedar grows in very good soil.

The park of Fromont, at Ris (Seine and Oise), which belongs to the Chevalier Soulange-Bodin, occupies a hill-side exposed to the north, and which extends to the banks of the Seine. The soil on the hill-side is of good free texture, on a calcareous rocky subsoil; in the valley the soil is deep, but it is sandy, flinty, and very poor. There are, near the castle on the hill-side, two cedars planted in 1813, which, when measured on the 31st of July 1844, were—No. 1, 7 feet 3 inches in girth, and No. 2, 6 feet 2 inches; the thickest was well branched, but did not appear to me to be more than 55 feet in height, and the smallest 65 feet. Other cedars had been planted ten years later, some singly, others in clumps. Those which were in the middle of the park, that is to say, in the most fertile soil, and which stood alone, girthed from 5 feet to 5 feet 6 inches; and those grown in a confined state in the same soil, girthed from 3 feet 6 inches to 4 feet, and about 50 feet in height. Those on the highest part of the hill-side, where the calcareous rock is nearest the surface, are grown close together, and girthed from 3 feet to 4 feet, with a height of about 55 feet. Lastly, those in the valley on the bad soil, and which stood alone, girthed from 4 feet to 4 feet 6 inches, and from 3 feet to 4 feet where they stood close together. The firs and pines, planted at the same time as the cedars, were far from having attained similar girths, and their height in clumps was also less.

M. Guy's garden is situated upon a hill-side exposed to the south-east, the soil has little depth, and the subsoil is a calcareous stone, impenetrable by roots; but in some places they have laid down rubbish from the buildings pulled down in St Germains, where they use plaster for building, the same as in Paris. Thus this forced earth, upon which twenty-two cedars have been planted, is of pretty much the same nature as the soil of the labyrinth in which the cedar in the Jardin des Plantes is growing. It is noticed that the cedar succeeds well here in such soil, and the *Pinus Laricio* does middling, while the silver fir, Scots fir, and larch are stunted, and the Weymouth pine does not do at all. M. Guy, the father of the present proprietor, made the garden in 1775, and the cedars date from about that time. Several cedars standing alone were, when I measured them on the 12th of August 1844, more than 6 feet 6 inches in girth, the largest being 7 feet 6 inches; and their height was from 40 feet to 50 feet. The cedars which were grown close together were less thick, but they were taller. They appeared to be from 65 feet to 70 feet in height, the girth of the thickest being 6 feet 7 inches.

Loudon (*Arboretum*, vol. iv., p. 2426) gives the dimensions of several Cedars of Lebanon growing in Great Britain. I will mention those of which he gives the age, and that have attained a large size relatively to their age, and from these the annual increase can easily be calculated.

At Luscombe, a cedar thirty years planted was 47 feet in height, the trunk 2 feet 6 inches in diameter. At Farnham, fifty years planted, 70 feet in height, diameter 4 feet. At Ockham Park, thirty-four years planted, 45 feet in height, diameter 2 feet 6 inches. At Bowood, fifty years planted, 60 feet in height, diameter 3 feet 6 inches. At Donnington Park, eighty years planted, height 62 feet, diameter 8 feet 6 inches. At Ditton Park, ninety years planted, 80 feet in height, diameter 5 feet. At Castle Ashby, age eighty years, height 72 feet, diameter 5 feet. At Croome, eighty years planted, height 100 feet, diameter 5 feet. The same author says that at Whitton, the *Pinus maritimus*, Scots fir, silver fir, and larch, growing in the same soil and situation as the cedar, have not made nearly as large a bole. It appears probable that many of the cedars in France and England have been grown from seed prematurely taken from the cones, and in consequence they cannot have attained the dimensions they would have done had the seed been perfectly ripe.

In order to know the largest size to which these trees can attain, we must examine them in their native habitats,—and first of all on Mount Lebanon, where the oldest known cedars are found. M. L.-Deslongchamps says that Corneille Le Bruyer, a Dutch traveller who visited these cedars in 1682, measured one which was 57 palms, or about 40 feet, in girth; that Maundrell, an English traveller, who visited them in 1697, measured one which he found 36 feet 6 inches in girth; and quotes a letter in which Dr Pariset, a French traveller, who visited them on the 2nd of August 1829, says that he did not measure any of them, but that they appeared to him to be as large as the pillars in the Palace of Carnac at Thebes, which are 42 feet in circumference. In the forest of cedars that M. Bové found in travelling from Tiberias to Damascus, these trees were, he said, from 3 feet to 18 feet in girth, and their height over 50 feet. In Africa, in a forest of cedars near Blidah, there are some from 12 feet to 16 feet in girth at 3 feet from the ground. In the forests of Ouarenseris, cedars have been cut down whose diameter was so great that it was necessary to join two blades of a saw, each 6 feet 6 inches long, in order to fell them. The largest cedar upon Ciga was said to be 95 feet in height from the ground to the first branches, and the stem varied from 5 feet 6 inches in diameter at the ground to 3 feet at the top. Cedars being more remarkable for their girth than for their height, this height of 95 feet without branches, appears to me extraordinary. It is probable that when all the forests of Algeria are fully explored, cedars of a still larger diameter will be found.

Loudon (*Aboretum*, vol. iv., p. 2426) says that the largest of two cedars which then remained in the Botanic Garden at Chelsea, was about 60 feet in height, and 5 feet in diameter at 4 feet 6 inches from the ground, and the other was nearly as large. At Wilton House there were several fine cedars one hundred and seventy years of age, and one of them 8 feet 8 inches in diameter at 1 foot from the ground. The cedar at Donnington, which is only eighty years old, and which I have mentioned already, on account of the rapidity of its growth, is only 2 inches less in diameter. At Chiswick there was a cedar 70 feet in height, with a diameter of 4 feet 6 inches. The tallest cedar in England appears to be at Strathfieldsaye; it was 108 feet in height, with a diameter of 3 feet. The tallest in the neighbourhood of London was at Claremont; it was 100 feet in height, with a diameter of 5 feet 6 inches. The finest cedar in England is probably, according to Loudon, at Syon; it is 92 feet in height, with a diameter at 3 feet from the ground of 8 feet, and the diameter of the spread of its branches is 117 feet.

Climate, Exposure, and Soil.—It was believed for a long time that the Cedar of Lebanon was only indigenous to Mount Lebanon proper, about 18 miles east from Tripoli in Asia Minor. Miller says (*Gardener's Dictionary*, vol. iv., p. 348, 1768), "The cedar of Lebanon, celebrated from the earliest days, and which, a very remarkable fact, is not found in any other part of the world except on these mountains." Nevertheless Pierre Beloñ, who travelled in the Levant towards the middle of the 16th century, and who first visited these cedars, saw some afterwards on Mount Amanus and on Mount Taurus. M. Bové, formerly director of the farm of Ibrahim Pacha at Cairo, during a botanical journey in Syria, in going from Tiberias to Damascus, found on the 11th of October 1832, between Sakhléhé and Der-el-Khamar, a forest of Cedars of Lebanon covered with flowers; it occupied the top of a mountain on the right hand of the road. Lastly, since the occupation of Algeria by the French, this tree has been found in each of the three provinces, Alger, Oran, and Constantine. There are forests of it, several square leagues in extent, on the mountains of Ouarenseris, situated in the province of Oran. There is also a magnificent forest of cedars not far from Algiers, near Blidah, which covers about 12,644 acres.

Authors, such as Baudrillart, who say that Pallas found the Cedar of Lebanon on the Altaian mountains in Siberia, are mistaken. Pallas does not mention it in his *Flora Rossica*, and they must have been misled by the common name of the *Pinus cembra*, called "*Kedr*" in Russian, a tree which is common on the Altaian mountains; besides, the cedar could not stand the Siberian frost.

The Cedar of Lebanon has hitherto been only found a native of warm climates, and there only on the highest slopes of the mountains. Those on Mount Lebanon are at an elevation where the snow lies for a long time, and where there are no habitations. The large cedar forest in Atlas, near Blidah, is more than 1200 feet above sea-level. In Europe this tree has been successfully cultivated, even in Scotland, where Loudon mentions (*Arboretum*, vol. iv., p. 2427) some from 3 to 5 feet in diameter. They have succeeded in growing it in Saxony, since, according to Loudon, there was one at Wörlitz planted sixteen years before, and which was 25 feet in height.

The cedar appears to be sensitive to severe cold, and to the alternations from frost to thaw so common in temperate climates, as for example in France. Varennes de Fenille, in the article "Larix orientalis," in his *Memoire sur l'administration forestiere* (vol. ii., p. 447), says—"the winter of 1789, which was so severe, killed most of the young cedars, whether they were covered with snow or not; and though many of the large cedars survived, they lost their leaves but put out new ones. All my cedars, the oldest of which were planted in 1804, lost their leaves in the spring of 1840, in consequence of a very mild February, which set the sap flowing, being followed by very cold weather in March; they became brown and fell off; but by far the largest number of cedars, both in my neighbourhood and in the other central parts of France, kept their leaves, as, for example, at two leagues distant, the cedar at Courteilles did not suffer at all from the change from a high temperature to a low one."

According to Loudon (*Arboretum*, vol. iv., p. 2412), the date of the introduction of the cedar into England is uncertain. Aiton, in his *Hortus Kewensis*, says that it had been introduced in 1683; but as this was the year in which the Chelsea cedars were planted, which were already 3 feet in height, they must have been introduced some years before 1683. The cedar is much more largely cultivated in England than in France, but only as an ornamental tree.

I cannot indicate the best exposure for the Cedar of Lebanon; it appears to thrive in all exposures in the centre of France, but it may be otherwise on high mountains, such as the Alps. The finest cedars in France are in the valleys; it is the same in England. The Cedar of Lebanon is not particular as to soil, and it seems possible to grow it in almost any soil. In the old gardens of the Tivoli Palace, in Paris, there were a dozen which were thriving well in 1844, though the calcareous subsoil was in some places at only a foot from the surface. The cedars in the Bois de Boulogne, near Paris, were also thriving tolerably well in a very poor soil, but it seems that this tree cannot be grown in siliceous soil as poor as that in which the *P. sylvestris*, *P. Laricio*, and above all the *P. maritima* can be successfully cultivated. M. de Larminat planted two hundred and fifty cedars in 1825, in the forest of Fontainbleau, at the place called Gorge-du-Houx, in very poor soil composed of white sand under a layer of peat; *P. sylvestris* and *P. maritima* being also planted there at the same time. In 1844 there only remained thirteen out of the two hundred and fifty cedars, and five of these had not grown at all, but were quite stunted. The tallest of the other eight was 13 feet in height and 1 foot in girth; the *P. sylvestris* of the same age, in the same place, were 35 feet in height and 3 feet in girth; the *P. maritima*, 32 feet and 2 feet 6 inches. The bad success of this plantation of cedars must be attributed to the aridity of the site, because some which were transplanted by M. Bois-D'hiver into good soil, throve afterwards. The soil which seems to suit the Cedar of Lebanon best, is a deep sandy loam. It is in soil of this nature that the fine cedar at Vrigny is grown; and near London, it is also, Loudon says, in a deep sandy loam that they succeed best, as at Syon and Whitton.

Culture.—It is generally thought in France that it is impossible to raise the Cedar of Lebanon successfully, except in pots or in boxes which can be protected in winter. Delamarre says, in his *Traité Pratique*, p. 139, "that the repeated attempts he has made to raise cedars from seed sown in the open border have failed, and that he has only obtained specimens from seeds sown in pots and protected." I think he is mistaken, because so many self-sown plants spring up, which brave the severity of the winter, and succeed as well as if they were protected, provided they are not destroyed by accident. I have raised Cedars of Lebanon in the open border; but I have lost many of them, which may have been caused by the seed which I had extracted with difficulty from the cones not being thoroughly ripe.

I do not know whether it has ever been attempted to sow the Cedar of Lebanon on a large scale in the open border. I presume, however, that it could be done successfully if the seed employed was perfectly ripe. The principal obstacle would be the difficulty of procuring the seed in sufficient quantity. In fact, the seed which is extracted with so much difficulty from the cones is generally soft, and probably only retains its germinating powers for a short time. If it is desired to gather the cones a short time before they would shed their scales and seeds, in order to be certain that the seed was perfectly ripe, it would be difficult to procure much, as the time of ripening is so variable; and, besides, if the process of germination has commenced, the seed must be sown immediately.

Pruning appears to be more hurtful to the cedar than to any of the other resinous trees; at least Loudon, who quotes Miller and Boutcher, brings facts in support of this opinion. I have found that the nibbling by hares of the lateral branches of newly planted young cedars has generally killed them, whilst it has only retarded the growth of pines, firs, and larches. Cedars must therefore be pruned with the utmost reserve, beginning upon isolated trees, at twelve years old, on the branches nearest the ground, at the rate of one or two branches only in the year. When these trees are grown close together, they prune themselves, but branches which are sickly may at once be cut off, as they would soon perish.

Qualities and Uses of the Wood.—It was long believed, on the authority of ancient testimony, that the wood of the cedar was incorruptible, and that it was one of the best trees both for building and fitting up ships. "The wood of this famous tree," says Miller, "is regarded as incorruptible." We know assuredly that its wood is light, because Varennes de Fenille found that a cubic foot of it, when perfectly dry, only weighed 32 lbs. Baudrillart states that Mussenbrack gives the weight of the cubic foot of this wood at 42 lbs. 14 oz., and Hassenfratz at 57 lbs., differences which were probably caused by the unequal dryness of the wood,

M. L.-Deslongchamps says that it has a strong resemblance to the wood of the pine, and still more to that of the fir; that the section of the trunk of a cedar is more like that of a silver fir than any other resinous tree. "The wood of the cedar," says this author, "burns quickly, crackling a great deal, and does not give as much heat as the oak, hornbeam, wych elm, or beech; its charcoal is very light, and yields very little heat, and is quickly reduced to ashes, like that of the poplar and the willow." Loudon, who was in a position to gather a great deal of information on the subject, since the cedar was cultivated sooner and in much larger quantities in England than in France, says (*Arboretum*, vol. iv., p. 2417)—"the wood of the cedar is of a reddish-white; light and spongy, easily worked, but very apt to shrink and warp, and by no means durable. A plank of cedar compared with planks of Scots fir grown in England, was found to be inferior to them in strength."

Diseases and Accidents.—In reference to these I cannot do better than quote the words of Loudon (*Arboretum*, vol. iv., p. 2425):—"The strong and spreading branches of the cedar are liable to be broken by the weight of the abundant snow which sometimes overwhelms them; but this tree is less liable to be blown down by the wind than the pine, fir, or larch, which have not, as this has, large and strong branches near to the ground. It is not subject to disease, and from what we have observed is less liable to be attacked by insects than any other species of the pine tribe."

Cedrus atlantica.—I believe that only two authors have yet written on the Silver, or Mount Atlas Cedar—M. Renou, in his "Notice sur les forêts de Cèdres de l'Algérie," from which I have quoted some passages; and M. Durien de Maison-Neuve, Member of the Scientific Commission of Algiers. The observations of M. Durien were transmitted to the Academy of Science by M. Bory, of St Vincent, in a memoir entitled "Sur les Cèdres de l'Atlas et l'emploi de leur bois dans les constructions mauresques d'Alger;" and this memoir has been inserted in the *Compte rendu des séances de l'Académie Sciences*, vol. xviii., No. 24 (June 10, 1844).

Loudon, in the article on "Cedrus Libani" (*Arboretum*, vol. iv., p. 2402), mentions a variety *Foliis argenteis*, but he says that the leaves are of a silvery colour on both sides, while those of the Silver Cedar of Algeria have this colour only on the under side. He adds that there are some beautiful trees of it at Whitton and at Pains Hill, and he is astonished that the nurserymen have never taken the trouble to increase this beautiful variety. M. Renou thinks that the Cedar of Lebanon and the Silver Cedar (*Cedrus atlantica*) form two well-defined varieties, while M. Durien says that the silver colour of the leaves is only an accident.

M. Renou, who was the first to mention the Silver Cedar, says, in the notice before referred to, that these trees occupy the forest near Blidah, which covers an area of about 12,000 acres, and there attain greater dimensions than the Cedar of Lebanon. It is not rare, he says, to find them 8 to 10 feet in girth, standing a few feet apart; and far from presenting any signs of decay, appear on the contrary making their greatest growth. M. Renou gives some drawings of the flowers and cones of the two varieties of cedars, and it is seen that the flowers and cones are perfectly alike; also, he has given but one description of these organs. He points out the difference between the two varieties, as follows:—"The cedars in this forest present two well-defined varieties. The first appears to resemble exactly the species acclimatised in France for a century under the name of 'Cedar of Lebanon.' The second differs considerably from the first; the leaflets are broader, yet not longer, they straighten themselves in taking their proper contour, as if they intended to converge to a common summit, which gives to the small clusters a roundish form. The decided character of this tree is that upon the top of these leaflets is a dull white colour, which produces upon the green shade of the leaves a silvery whitish appearance. The cones, before their maturity, have at the point of their scales a patch of this silvery tint, which is always less apparent than that on the leaflets. The branch which supports the cluster of leaves also presents a rather decided contraction of its lower part; but it is thicker than in the first variety, and the small crowns which remain after the fall of the leaflets are more decided. The branches extend themselves equally in horizontal layers; but they bend much more towards the ground than those of the first variety. This peculiarity appears, besides, to have been attributed to the difference in the weight of the leaflets, which in the Silver Cedar (*Cedrus atlantica*) are thicker and more covered with leaves, the lower layers bend much less than those of the Green Cedar (*Cedrus Libani*), and there is less disproportion between the length of the branches as they near the top. Its bark is of an ashy grey, thick, rugose, and formed of scales, which break off in particles when the tree has attained a certain age."

The wood of the Silver Cedar is of a whitish shade of yellow; its texture is rather close, and presents a certain homogeneousness, but is less heavy than that of the Green Cedar.

The differences which exist in the height and the colour of the leaves of these two trees are, besides, so apparent, that, to an eye a little practised, the difference between them may be easily distinguished at a distance.

M. Durien went over the same forest of cedars that had been gone over by M. Renou, and found there were not two species, as had been presumed on entirely incorrect information, and it was difficult to consider them even as simple varieties. The colour of the foliage depended upon various circumstances, but principally upon the age of the tree. In fact, says our learned traveller, I have observed a large number of cedars which present the two tints of foliage strongly marked, with intermediate shades, on the same tree; yet some of the largest, and consequently the oldest, trees presented only the silvery colour, which gave to them an appearance quite peculiar.

If the observations made by M. Renou are exact, it appears evident that there are two *varieties* of cedars in the forest of Blidah, the Green Cedar, and the Silver Cedar, and admitting the accuracy of the observations of M. Durien, they do not prove that M. Renou is mistaken. It may, in fact, be possible that the leaves of the Silver Cedar do not take the silvery tint until a certain age. It is not known that the leaves of the Cedar of Lebanon take the white colour when they grow old. Nothing of this is recorded as having been observed upon Mount Lebanon, where there are very aged trees; nor in England, where some are already in a state of decrepitude; nor yet in France, where many are approaching maturity, if they have not yet reached it.

Cedrus Deodara (the Deodar, or Indian Cedar).—Roxburgh, the first naturalist who observed the Indian Cedar, gave it the name of *Cedrus Deodara*. The common name, "Indian Cedar," recalls its native country. The Indians call it "Devadaru" or "Devdar," says Roxburgh, and they consider it a sacred tree. This tree is chiefly known from what has been said about it by Lambert and Loudon, and from botanists and travellers, who have observed it in its native habitats in India. From these sources we learn that the Indian Cedar is a native of the north of India, in Nepaul, and the Indo-Tartar mountains, where it is sometimes found growing at the height of 4500 feet above the level of the sea. Its botanical characters are the same as those of the Cedar of Lebanon; but its cones, flowers, and leaves differ a little from that tree in colour, and its cones are also thicker and its leaves larger. It is distinguished from the Cedar of Lebanon at first sight by its young shoots, which hang down like those of the weeping willow, but which become straight in the autumn and following spring. This disposition of its shoots, and the pyramidal form of the tree, give to it a most graceful appearance. It acquires magnificent proportions in India, where it attains the height of 150 feet, with a circumference of 30 feet.

Its wood differs much from that of the Cedar of Lebanon; it is very compact, very resinous, diffuses an agreeable perfume, and appears possessed of qualities which the ancients attributed to the wood of the Cedar of Lebanon. It takes such a beautiful polish that a section 4 feet in diameter, sent by Wallich to Lambert, appeared to be a piece of agate. The wood of this tree is employed in the manufacture of all kinds of things. It is so lasting that it is used as a shelter exposed to the air or in water. It has been found perfectly sound in the timber-work of Indian temples, which were not less than two hundred years old. Dr Lindley says that Moorcroft sent him a piece of this wood, which was part of the bridge of Zein-ool-Kuddul at Ladak, where it had been exposed to the water for almost four hundred years. Loudon, who tells this fact (*Arboretum*, vol. iv., p. 2431), does not say in what condition this wood was. The same author repeats after Moorcroft, that Rajah-Schah had employed in the construction of a house some of this wood, still quite sound, although procured from the ruins of an edifice built two hundred and twenty-five years before by the Emperor Akbar.

The Deodar, or Cedar of India, was introduced into Britain, in 1831, by Mr Leslie Melville. It has grown and thriven perfectly in the open air, even in the north of Scotland, and it has been found more robust than the Cedar of Lebanon, and does not appear to suffer much from the severe winters nor late frosts.

Loudon says (*Arboretum*, vol. iv., p. 2432) that the price of cedar plants in the London nurseries in 1838 was two guineas each.

XV. *Notes on Tree Planting at San Jorge, Uruguay, South America.* By CHARLES E. HALL, of San Jorge.

Situation.—The estate of San Jorge lies in lat. 32° 43′ S., long. 56° 8′ W., about 160 miles N. of Monte Video, and about the same distance from the sea, the river Uruguay, and the Brazilian frontier. The altitude of the highest ground above sea-level is probably 400 feet, falling to 280 feet on the lowest ground.

Preliminary.—San Jorge was originally the name of an estate of about 330 square miles, belonging to the late Mr Thomas Fair of Edinburgh, sold off in portions and at various dates since the year 1867. The head station became my property in 1876, and now, with about 10½ square miles of land, retains the old name. In 1876, in the garden-ground round the house, there were about 180 robinias (*R. Pseud-Acacia*), 120 Lombardy poplars, 50 paraisos (*Melia Azedarach*); a few ornamental trees, perhaps 20; and about 320 fruit-trees, chiefly pears, apples, oranges, figs, peaches, and quinces, also a few apricots, plums, cherries, pomegranates, and vines. I shortly after planted a few more fruit-trees; and in July 1880 made my first small plantation of trees for business purposes.

Character of Country.—Uruguay is almost universally bare of natural woods, save along the margins of streams and rivers. The country is undulating, generally pretty well watered, with low hill-ranges, some rather stony, some with no surface stone, of no great elevation over the dividing water-courses, in few cases rising more than 100 feet over the nearest running water, and generally descending to the water-course levels by easy slopes. These water-courses do not invariably and always contain water. Such is the character of the San Jorge district, and of much of the western and southern parts of Uruguay. To the north and east the land is more rocky, the hills bolder and higher, wood more frequent, and not entirely confined to the banks of streams, being sometimes found in clumps in rocky dells. But even in Southern and Western Uruguay, tala (*Celtis Tala*) and espinillo (*Acacia Farnesiana*) are in a few parts found on dry stony hill-tops or plateaux. The imperishable "ñandubay," which no drought affects, is also an exception to the rule that woods grow exclusively on the banks of streams.

Indigenous trees, besides the three above mentioned, are not very numerous; the most valuable being coronillo (*Scutia buxifolia*), molle (*Duvaua dependens*), "vivaró," guayavo (*Feijoa Sellowiana*), and willow (*Salix Humboldtiana*). There are other kinds that seem to be useless except for firing; and the "mataojo" (kill-eye) (*Lucuma Sellowii*) is not even useful for that, so pungent is its smoke. When the water in a stream begins to be fairly permanent, the Sarandi shrub (*Cephalanthus Sarandí*) is to be found, interspersed a little farther down with mataojos, willows, molles, possibly some ceibos (*Erythrina Crista-galli*) or laurels (*Oreodaphne acutifolia*); and as the stream gains in width, so does the belt of trees on the banks, until it reaches the main water-course, which for the San Jorge district is the Rio Negro. But the last thirty years have seen many streams, formerly well wooded, denuded of their trees; and even in the woods of the Rio Negro, that vary from two or three hundred yards to, in some parts, more than a thousand yards in width, the felling of wood, in season and out of season, has been carried on so recklessly that the best qualities of wood are now becoming very scarce, and all wood sensibly diminished in quantity. There are parts of the Rio Negro where the banks are not wooded, but these are few and far between; and they occur where the banks are high, and are never overflowed, even when the river is swollen with excessive rain. A small stream sometimes collects the rainfall from a large district, and is promptly converted by heavy rain into an impassable furious flood, overflowing its banks to a very great width in some places, and sometimes covering the tops of all but the highest willows; these streams run into each other, and eventually the Rio Negro receives them all, and its stream is enormously multiplied; what might in ordinary weather be a stream of 80 to 200 yards width, after heavy rain becomes in some parts a river 4 miles broad or even more. This periodical, or rather occasional, inundation leaves much debris of vegetable matter among the woods on the banks; and the trees, though many of them are entirely submerged for a period of from two or three days to perhaps as many weeks, do not seem to suffer at all. Nor do they appear to suffer when, as has happened, more than two years have elapsed without any flood. Grassy glades exist here and there among these natural woods of the Rio Negro, and cattle come in to browse, but do not appear to do serious harm even to the young plants, that follow the path of the woodcutter's axe.

These occasional inundations effectually prevent the formation of the nests of the black or leaf-cutting ants, probably the greatest foe to wood-planting in Uruguay.

The soil of San Jorge district is of very varied character, in some parts a deep, stiff, black clay, difficult to work, but very rich; in others light black loam, intermixed with sand; there are also some patches of gravelly soil, apparently old moraines, excellent for trees; and in some parts a cold grey clay occurs, pretty deep, that holds water long, never grows good grass, and is our worst land. The stone is chiefly amygdaloidal; there is also a good deal of conglomerate sandstone; some true felspathic sandstone, approaching tuffa in composition; a little quartzite, grey and liver coloured; and there is also a dyke running across, of close-grained volcanic rock.

Meteorological.—The mean annual temperature, as ascertained by me from nine years' observations, taken at San Jorge by the generally received scientific methods, is 60°·9 F.; spring and autumn averages running from 72° maxima to 49° minima, summer from 84°·7 to 58°·4, and winter from 60°·5 to 41°·3. December, January, and February are taken as summer months, June, July, and August as winter months. The highest shade temperature recorded in nine years is 101°, and the lowest 23°. The daily range of temperature for spring and autumn is 22°·3, for summer 26°·3, and for winter 19°·2. The average annual rainfall is 46 inches, falling on 94 days, and with a duration of 329 hours per annum. April is the rainiest month, and then September; February being the driest. There is an amount of cloud of 1670 out of a possible 3650; thus it may be said that on 4 days out of 9 clouds hide a sky, which for the other 5 days is cloudless. There is an annual average of 2836 hours of sunshine out of a possible 4368½ hours. The average dew-point ranges between 48°·3 for winter to 60°·9 for summer, and relative humidity from 53°·6 for summer to 78°·2 for winter; spring and autumn averages being at almost equal points between summer and winter. It is not at all infrequent to find an inch of rain falling in one hour; 3 or 4 inches have also been measured for durations of five and six hours. The two years July 1886 to June 1888 gave 65 inches of rain, or 32½ inches per annum, whereas the twelve months July 1888 to June 1889 gave 79 inches. These meteorological notes, extracted from a record of nine years, show that the climate is variable, and its extremes accentuated.

Long droughts prevail sometimes, and sometimes long-continued rains; and neither can be forecasted. In 63 days, between 1st February and 4th April 1881, only 0·86 inch of rain fell; in such hot weather this amount would have no perceptible influence on growth; it might suffice to wash dust off leaves and grass, and on the parched ground would run into the land-cracks. As there is a decided growth of grass in autumn, when rains assist, that year there was but poor winter feed for cattle. In 65 days from 28th June to 2nd September 1886, only 1·01 inch of rain fell. This drought caused little or no harm, as little or no growth can be expected in these months. A more serious drought succeeded from 21st September 1886 to 13th January 1887, 114 days, when only 6·40 inches of rain fell; this term following a dry winter, and embracing all spring and half summer; and this was not all, as the remaining half of the same summer, with the following autumn and the beginning of winter, 167 days from 14th January to 30th June 1887, only obtained 12·76 inches of rain.

There was plenty of rain in spring 1880 and early summer following; but had the season, July 1880 to June 1881, when I first began tree-planting, proved as dry as the seasons 1886–87 and 1887–88, I should probably not have repeated the experiment; the season, however, on the whole, was fairly moist, and the rains were distributed with some degree of equality. Thus, though we had had no experience as to the best mode of planting trees, our success encouraged us to try again; and when in after years newly-planted trees, on two or three occasions, suffered from long-continued frosts, or from prolonged summer droughts, I have looked on these failures as on incidents that may occur in all businesses. As examples of frosts, I extract from my records that for five nights running in July 1886 the average minimum thermometer was 32°, the highest minimum record being 34° in a sheltering instrument box, 4 feet above grass. In this same July, for another period of seven nights running, the average minimum was 29°·3, the highest minimum record being 33°. In the following August, one period of five nights averaged 31°, with a highest minimum of 34°; and another period of six nights averaged 30°·3, with a highest point of 32°. The lowest temperatures to which the trees were exposed on different nights of these periods were 29° four times, 28° twice, 27°, and 24°.

Amount of planting done, chiefly since July 1880, for though a few trees were previously added to the 700 existing in January 1876, I do not think they were more than 100 or 200. My "Plantation Estimate" for April 1889 shows that I have, on about 150 acres, at least 74,200 trees, as thus:—

33,250 robinias (*R. Pseud-Acacia*),
18,260 blackwoods (*Acacia melanoxylon*),
19,560 Lombardy poplars,
3,130 sundry trees,

and I have since then planted about 5000 more, on about 10 additional acres. But I have not ventured to estimate the multiplication of trees, resulting from replacing the felled robinias, poplars, or blackwoods; there are doubtless many thousands of these young plants.

The earliest, and the subsequent methods of planting, differed slightly. The first trees were planted thus: holes about 2 feet wide and 15 inches deep were dug in lines, 10 feet apart, and the earth heaped up alongside; after a month or so we began planting out young robinias, being plants that had sprung from the cut roots of other robinias; also blackwoods, plants grown from seed by ourselves, and about ten months old; we filled in the earth with care. Robinias did well, but many blackwoods died.

The next season, having found that leaving the holes open sometimes gave extra work in baling out water after heavy rain, we dug the holes just as they were required to receive the trees, and filled in with surface mould; also, we were much more careful to keep the soil in which the young blackwoods were growing still well adherent to their roots, carrying the plants carefully in boxes, etc. This season we were more successful, and arrived at the conclusion that robinias bore transplantation so well that no special care was wanted for them. We then tried a poplar plantation on a dry slope of ploughed ground, putting in cuttings 4 feet apart, with about three eyes above and three eyes below ground. These did fairly well; better about the middle of the slope than where it died off to a level. But we unwisely utilised the ploughed land by sowing pumpkins, melons, etc., among the cuttings, and the strong winds blowing their vines about the young tree-cuttings did harm. We also had extra work with weeds, not having kept them well hoed down.

The succeeding season we ploughed up about 9 acres in January, cross-ploughed and harrowed in May or June, and then put in blackwoods and robinias in 10-foot lines, digging but small holes, the earth being nicely pulverised for filling in. We had heavy rains whilst this work was going on, and the ground being sloping, our young plants were frequently washed out and carried down to the bottom of the slope,—doubtless many plants were thus replanted two or three times,—but as a whole the plantation was fairly successful, and I have since invariably ploughed up land in midsummer for plantation at the end of winter with rooted tree-plants.

Forms of Plantations.—The first plantation on land purposely ploughed up for it was an irregular quadrilateral; and in subsequent years I planted some parallelograms, some 120 yards, some 100, and one 80 yards broad, ploughing prairie-land in January, cross-ploughing and harrowing in May and June, when the land was fenced in with a five-wire elastic fence, and the trees planted in rows 10 feet apart. These tree-plants were obtained from nurseries made the previous August or September, almost entirely of robinia and blackwood. For the very first plantations I availed myself of young plants of robinia that had sprung up from roots of older trees cut down; and every season I have some of this class of young plant to put out.

For the last three or four years I have preferred to plant long belts, 40 yards wide; these belts I do not cross-plough; but a second ploughing in May leaves the ground in fair condition. I do not think the trees do so well in the narrow belts as in the wider plantations; but consider that other gains balance this loss. The belts are planted along the side of a field, utilising the field fence for one side, and the belt thus soon gives shelter to two fields; and for the same outlay for young trees and plough-work, the length of doubled fence, filled in with woods growing between two fields, is doubled in proportion to whether the belt be 40 or 80 yards wide. Thus a narrow belt will sooner completely separate the stock of two adjoining fields; and a scabby sheep in one field (they always will rub against wires and fence-posts) will not then communicate the disease to sheep in an adjoining field. The advantage of this especially applies to boundaries with neighbours, from whom before long my land will be separated by belts of trees.

Classes of Trees Planted; and Where, and Why.—When the ground of a plantation dips, where it crosses a stream or hollow, I plant cuttings of poplars and willows about 4 feet apart, even where the plough has not been able to turn over the uneven ground.

Experience has shown that in hollows the blackwoods suffer and even die from the severer frosts, so we now keep them chiefly to the slopes and higher grounds, where the frosts do them little or no harm.

Robinias do not perceptibly suffer from frosts, but do not like marshy or low ground, where, even if they grow at first, many plants subsequently die out.

I have planted poplars on high ground with good success, but none do so well as those planted in low ground with good surface natural drainage.

I have also planted a few paraisos; they do fairly well; also a few sorts of coniferæ, some blue gums, and others eucalypti, catalpas, mulberries (from cuttings), and many other trees, some few indigenous, but only a few of each sort. Lately I have planted out one hundred or more young English oaks from acorns produced by some few older oaks on the place, and purpose continuing the plantation of these, of mulberry cuttings, and of cuttings of Carolina poplar (cotton wood?), which grows very fast, and which I think a convenient plant to put in where young transplanted trees have failed; a man can easily and quickly fill in gaps with cuttings, but to fill in gaps with young rooted trees is a long and costly job.

Acacia mollissima or dealbata (silver wattle) grows wonderfully fast, but is troublesome to rear as a young plant; the same is true of the Eucalyptus family. *Acacia lophantha* grows particularly fast, but I fear will not suit: I planted out 1000 rather well-grown plants in August 1889, and am informed that all subsequently died, probably, or certainly, from a severe succession of frosts.

Economic Reasons for and against certain Trees.—I want trees to give shelter to stock, to yield serviceable posts for wire-fencing, and timber for hut or rancho building, and roofs thereof, and eventually perhaps planking for various purposes, also for firewood. Robinias give excellent durable posts at ten or twelve years old; if the tree is cut in proper season it grows up quickly from the roots. It yields trifling shelter in winter-time, but its topwood is excellent for firing. It is not very greatly persecuted by the black leaf-cutting ant, or by other insects.

Blackwood gives excellent shelter, being evergreen, and is very good firewood; as a post, it does not last in the ground, but it splits up most readily into the light bars, through holes in which the wires of our so-called swinging or elastic fences are passed, and for which there is a considerable demand. It would saw up into useful planks at ten years old. Poplars sell easily for hut or rancho roofs, and if allowed to grow long enough, would doubtless give good planks for flooring, for sheep-hurdles, etc. A four or five year old poplar plantation, at 4 feet between the trees, breaks the wind admirably, even when the trees are bare. Poplars suffer from ants, but generally manage to survive their attacks; they are most easily planted, and reproduce themselves manyfold after cutting. The same is true of the blackwood, and this, according to our experience, does not suffer from black ants, though I am told that some people have found that the ants do cut the leaves of this tree.

Firewood is always saleable. Quick-growing trees that reproduce themselves are of course best for this purpose. *Acacia mollissima* (silver wattle) is, I think, the quickest grower we have, unless it be *Acacia lophantha*, and it reproduces itself when cut in good season; but it is especially persecuted by ants, which makes it a very expensive tree. The same holds good of the Eucalyptus family, so far as I have tried them; moreover, these do not seem to reproduce themselves when cut; they are susceptible to frost in low grounds, and when well grown, trees are troublesome to split for firewood. *Pinus pinea* grows handsomely, but is greatly troubled by ants, as are also *P. insignis*, *P. maritima*, *P. canariensis*, and others I have tried. The only conifer I have that the ants don't attack is a small but healthy specimen of Norway spruce brought from Chester nine years ago, and now about 5 feet high. If *Acacia lophantha* will not suit, I believe the best trees to grow for firing purposes will be found to be blackwoods and Carolina poplars.

The indigenous trees grow very slowly when transplanted from their natural habitats, the occasionally submerged margins of streams. Ants damage some of them, but not very much. The moist air along the river banks, and the cooler ground under the trees of the native woods, must offer to a young tree a pleasing contrast to a hill-side, or even valley, in the open ground, where no trees keep the soil cool or retain moisture, and where the heavy rains tend to carry fertilising vegetable matter to the river-courses, where much of this is deposited among the growing trees and brushwood, and much, unfortunately, swept away to be deposited miles out at sea. I hope to be able to secure ripe seeds of some of the indigenous trees, and when some of the hollows now planted are partly covered with wood, to try young indigenous plants in gaps therein. I could not count upon getting young plants from the natural woods in any number, nor at the time when required, and they would undoubtedly prove costly.

The tala (*Celtis Tala*), indigenous on the Campos, grows well from cuttings, though I have not been very successful myself; but we plant cuttings of this and mulberry in nursery beds, and then plant out after a year. The tala grows fairly fast, and is a useful wood.

Acer pseudo-platanus grows tolerably well, and is not much troubled by ants; the same may be said of the paraiso. But all these are slow-growing in comparison with blackwood, and do not give the same shelter as that evergreen. Though I have not tried *Acer pseudo-platanus* as a post, I am sure neither it nor any of the others can compare with robinia for duration below ground.

Nine years ago I had a consignment of British trees from Messrs Dickson of Chester, for curiosity and ornament. Several sorts of sycamore have done fairly, beeches also, and a lime survives; some elms and ashes are growing, and also a holly. Horse-chestnuts live, and that is all they do. Birches died; lilacs and others were quite killed by ants. Ashes also suffer much from ants. But all these trees are very small. They all look lively towards end of autumn, get along well through winter, and burst out bravely in spring; but when the hot north winds blow and drought is felt, their leaves get dry, fall off, and the tree gives in until the cooler autumn returns. The beech and holly I think do the best, and then the elm.

These British trees are planted on a rising-ground, and have never had any "nurses"; if they had had, possibly they might have grown very much better.

When I made my first nine-acre plantation on ploughed land, I utilised the ground by sowing three rows of maize between the rows of trees. In summer the maize overtopped the trees and kept the ground cool; in winter the dry stalks (for I pulled the maize-cobs instead of cutting down the stalks) sheltered the young trees to some extent from winds. And this I did a second year also, but feared to do it a third year, the trees being well grown-up and liable to injury by our clumsy oxen working the plough among them. And in every plantation of trees grown 10 feet apart, I have continued this practice of sowing three rows of maize for two years, partly for nursing purposes, and partly to recoup my expense in ploughing and fencing the land. I have also latterly sometimes sown two rows of maize only in the third year.

Damages to plantations, except from droughts and frosts, are not numerous. The black leaf-cutting ant is certainly the worst; and it is only by choosing for planting the trees not greatly affected by them, that this trouble may be almost avoided. However, even with trees that greatly suffer from the black ant, success may be obtained, but at an enhanced cost. Ants of course do their damage in the early years of a tree's life, and protection may be afforded a tree by isolating its trunk from the surrounding ground with a 4 inch wide zinc cylinder, 6 inches high, with a 2 inch "brim" soldered to the top of the cylinder at an angle of 45°; the ants cannot turn the angle where the brim is united to the cylinder.

Other mechanical devices are used to keep the ants from getting at a young tree stem, all troublesome, all more or less expensive, and all requiring attention, to see that no casual bridge is formed anywhere.[1] The radical cure is extirpation of the ants; and though that can be done where there are many neighbours, all helping, in valuable land near towns, it is impossible in the open country—and even the destruction of nests is expensive, though we do it in the neighbourhood of seed-beds of the gardens and orchards, etc. This ant cuts off and carries to its nest leaves and twigs at its own discretion, carefully discriminating between classes of plants; it is my belief that all this harvest is stored in the subterranean nests, and subsequently devoured, and that probably after having undergone some fermentation. For this idea of the necessity of fermentation I am indebted to a friend, a doctor, and most observant man, who lived for some years on San Jorge land. It is certain that ants like working in early morning whilst the dew lies, desist during the hot hours of the day in summer, and are most noticeably active just after a shower. In winter they do not work until the frost has quite disappeared. When a nest has been destroyed, in the efficient way in which we do it, some ants certainly escape, perhaps chiefly

[1] Cyanide of potassium and other poisons are useful to keep down their numbers.

in the long tunnels connecting their nests with the open air, and these scatter abroad, and probably form three or four new colonies, small to begin with, but very revengeful of the wrong done to the parent nest.

In the San Jorge district the great devouring locust has as yet appeared only in very small numbers, and very rarely, I am grateful to record. The smaller locust, perhaps more properly a cricket, though a terrible scourge to pasture, does no harm, so far as I have observed, to trees, but I think it might do so. This insect plague is not, however, always with us, like the ants, and years may elapse before a destructive season or two is repeated.

A white borer-worm, or grub, perforated in all directions the trees in an avenue of paraisos I made perhaps ten years ago, and the young branches decayed and fell off, but after a year or two the plague or borer-worm apparently left the trees, and they have grown since excellently well. I think the trees were perhaps three years old when this attack was made on them. In plantations made where long coarse grass is abundant, either inside or outside the plantation, the young trees are liable to be barked to death by the wild guinea-pig (*Cavia aperca*). I have also had willows and osier-willows, planted in boggy islands in the middle of swamps made by streams, barked and killed by, I certainly believe, the nutria (*Myopotamus coypus*); now, I am sorry to say, rather a rare animal with us. If cattle get into the fenced plantations they rub off branches, and do damage; and at one time I purposely admitted sheep into plantations, partly to keep down grass and partly for the shelter; but they nibbled off young shoots coming up from cut-down trees, and rubbed themselves against the bark of well-grown trees, and have since been banished as much as possible from the inside of our plantations.

General Remarks.—The grass naturally grows very rank and long in these ploughed plantations, and I always fear what the accidental or intentional dropping of a lighted match or cigarette might do: so far no loss has occurred thus. But I hope that I may now obviate this great danger to some extent by cutting the grass for hay, baling it up, and possibly obtaining a sale sufficient at any rate to pay the expenses of this partial insurance. I have tried hedge-making or planting inside the wire fence, but have not yet succeeded in getting a good hedge, partly perhaps from having been too chary of expense in the first planting of the hedges, and partly perhaps because I have not yet found out any plant sufficiently good for the purpose.

I invariably prune robinias and poplars, the former up to perhaps 5 feet high, thinning out upper branches also, when too numerous, and the latter up to 7 feet high. The blackwoods, I consider, are better when left unpruned, having tried pruning them up to 5 feet or so. The various other trees I have planted in small numbers have also been attended to in this fashion. And for this sort of pruning I like to choose the height of summer, as the trees do not then send out from the cut branch a multiplicity of young branches.

When preparing wood for sale, I have made a practice of barking the trees within twenty-four hours of cutting them down. The bark comes off most easily, and I daresay its economic value as fuel, when dry, nearly pays the expense of barking; and I believe the wood for posts, or for roof, rafters, etc., lasts better when peeled. I believe the very end of summer and all autumn is the best time for felling blackwoods, robinias, and poplars, taking into consideration that I wish for well-ripened wood, and for reproduction from the tree-stumps.

All the lop-wood is serviceable for firewood. In future days, if the amount of lop-wood becomes unmanageable, I fancy a large proportion might be convertible into charcoal, and think that this would be easily saleable.

Almost all European fruit-trees do well, pears perhaps the best of any. Oranges are not so sweet as those of Paraguay and Brazil, tropical climates, but are particularly clean and free from the sort of mildew that marks with small dark specks or lines the generality of tropical-grown oranges. Apples are not particularly good; peaches, nectarines, and apricots, if carefully cultivated, are good, but by no means equal to British fruit. Walnuts and olives do well. Quinces suffer much from worms inside them in many seasons; the plant itself grows so freely from cuttings that I have made hedges of quince; and where protected from sheep and cattle it makes a fine thick hedge, but of course of no great utility. Figs grow most luxuriantly, so do vines, where the science of viticulture is understood. Wine-making will probably before long become an important industry in Uruguay.

For some few years I have been taking monthly measurements, at a marked line, of sundry trees, and find that the average annual increment in girth at 3 feet from the ground of—

Blackwoods	is about	3	inches.
Poplars	„	$2\frac{1}{4}$	„
Robinias	„	$1\frac{1}{2}$	„
Silver Wattles	„	$5\frac{1}{2}$	„
Oaks and Paraisos	„	$2\frac{1}{2}$	„
Eucalyptus	„	$3\frac{7}{8}$	„

The evergreens seem to have no distinctly marked period of rest; the deciduous rest from middle of April to middle of September as a rule, some beginning and some ending their rest a little earlier or a little later. Between middle of April and middle of May there is a slight shrinkage of measurement in paraisos, robinias, and especially poplars.

For the benefit of my neighbours in Uruguay, I may state that the expense of planting trees as I have described is but small, and greatly reduced when two or even three crops of maize can be taken off the first ploughing and fencing expenses. Though I only began planting for business purposes in 1880, I have made a considerable number of small sales of wood during the past two years, and see no reason to doubt that in two or three more years, the balance now to debtor of plantation account will have been cleared off, leaving me with probably 150,000 trees of various ages and values, of which I might fell one-tenth annually, and still leave a good proportion to grow up to large wood, for planks, beams, etc.

Apart from the pecuniary returns from these woods, the shelter afforded to stock in our occasional bitter cold winds and wet storms from S.W., S., and S.E., must tend toward maintaining the condition of the stock, and consequently towards the returns from the estate.

It is perhaps too much to suppose that such a trifling area of plantation, in an almost woodless country, can affect the rainfall, but I am bold to dream that a passing rain-cloud is more likely to discharge some of its contents over San Jorge than over neighbouring lands entirely bare of trees, excepting in some cases a few round a house, rarely so much as an acre. The estates within 50 miles of San Jorge that have as much as 20 acres of planted trees could probably be counted on the fingers of one hand; I am not sure that any have as much as 20 acres, but possibly one or two may have as much, or even a little more.

The government of Uruguay recognises the utility of tree-plantation, and exempts from the yearly land-tax land planted with trees of a minimum area of (I believe) 100 acres. I claimed exemption two years ago, which was granted. I do not think any other exemption was made in our department, but there may have been in other departments.

With one or two exceptions all the labourers who have been working for me at plantation and other work are natives of the country—I might almost say, of San Jorge.

XVI. *The Forest School at Eberswalde.* By A. C. Forbes, Farnham Royal, Slough, Bucks.

The Royal Forest Academy at Eberswalde, in the province of Brandenburg, is (in conjunction with the Forest School at Munden, in Hanover) specially intended for the training of candidates for the Prussian forest service, and is controlled by the Minister of Agriculture, Domains, and Forests. Neustadt, Eberswalde, in the centre of which the academy stands, is a thriving and rapidly increasing town, about thirty miles north of Berlin, and is connected with the capital by the railroad between Berlin and Stettin. It possesses a population of about 16,000 inhabitants, and contains several extensive manufacturing works, which together employ a great number of hands. It doubtless owes much of its prosperity to the fact that it lies along the route of the Finow Canal, which skirts the north side of the town, and which affords cheap transit of goods either to Berlin or Stettin. This canal joins the river Oder at Oderberg, a town about twelve miles from Eberswalde, where many large saw-mills exist; and large quantities of timber are floated down to Stettin, there to be manufactured and shipped. Several large saw-mills also exist at Eberswalde, for which the surrounding district provides abundance of raw material. The general appearance of the country, for miles around, closely resembles the counties of Moray and Nairn, although it is more heavily timbered, and none of those characteristic heathery moors are to be seen, the State being under the impression that timber-growing pays better than heather. The soil is extremely dry and arid, being little but white sand, although beds of clay and marl are met with here and there. Agriculture, in the immediate vicinity at least, cannot be said to be very highly developed, being chiefly confined to the cultivation of rye, potatoes, etc., the damper portions laid down to pasture, the nature of the soil being rather infertile generally.

The town of Neustadt, Eberswalde, consists of two portions, the older lying to the east, with the streets rather narrow and badly paved, but they are kept very clean, and appear to have been laid out with some regularity. The older houses are almost entirely of wood, and substantially built. In the newer portion the streets are broader, and planted with trees, the principal street leading to the railway station being fully a quarter of a mile in length, while a still longer one has been anticipated by planting a double row of trees, extending in a westerly direction from the town. On the south side the ground rises rapidly to the margin of the forest, which extends both right and left for several miles. The ground on the left side of an oblong sheet of water, formed by the widening of a small stream, and which lies close to the old town, is laid out with beds of shrubs; a broad walk planted with trees, running through its entire length, being the most frequented promenade in the town. In the centre a small cairn of boulders has been erected to the memory of those natives of the town who fell in the wars of 1864-66 and 1870-71. A continuation of this promenade leads to the forest garden of the academy, which is open to the public. Numerous restaurants and hotels are erected along the road leading to the garden, the special facilities for enjoyable walks and drives which the district provides causing a great number of families in Berlin, etc., to make it a summer resort. The town also possesses several thousand acres of forest land, part of which is laid out with walks, and provided with seats, etc., and contains several small sheets of water in which aquatic plants, etc., have been placed, while a shooting range and gymnasium provide recreation for the male sex. This town forest is managed very much in the same way as the surrounding State forests, except that clear fellings are not performed in the part devoted to the public, and no removal of trees allowed that would interfere with the amenity of the forest; and, at the same time, no extravagant "landscape" improvements have interfered with its natural aspect. A few acres near the railway station, which command an extensive view of the surrounding country, are being laid out as a public garden, with beds and miniature lakes.

The original commencement of forestal instruction at Eberswalde was in 1830, the school itself having been in existence at Berlin for the previous ten years, being connected there with the university. The cause of its removal from that city was solely on account of there being no available forests for practical demonstrations, it being found that the references to forestry work and administration were in many cases imperfectly understood by the students, while the instruction given was of too theoretical a nature. This led to a large private residence being purchased in Eberswalde, and converted into a school in 1830, the number of students transferred to it from Berlin being twenty-five, while the teaching staff consisted of three professors only—one for natural history, mathematics, and forest science respectively. The following outline of the ultimate development of the school, extracted from a work published by Dr Danckelmann in 1880,[1] may prove interesting:—"The number of new students admitted during the first session of 1830 was thirteen, making a total of thirty-eight altogether. In 1831-32 the forest garden was laid out, partly as a botanical garden, and partly as an experimental garden in connection with forest trees. In 1836 a lecturer on civil law, in relation to forests, was appointed. In the following year a seed-kiln was erected in the forest garden (a model of which is in the museum of the academy). In 1850, twenty years after its removal from Berlin, arrangements were made for imparting the whole of the scientific instruction at the academy, the students hitherto being required to attend the university at Berlin for certain subjects, before they were admitted to the higher branches of the State service. The following year a second professor of forest science was appointed, and another forest garden was formed at Chroin, in one of the Oberforstereien in which instruction is given. In 1866 a chemical laboratory was erected, and a professor and assistant of inorganic chemistry appointed. In this year, also, a regulation was made to the effect that students who intended to go through a full course of instruction should only be admitted at the beginning of the summer session of each year, they having previously been taken in at any period of the year. In 1867 an assistant to the professor of natural science was appointed, and two years later the appointment of a professor of zoology caused the botanical and zoological departments to become distinct branches, they having up to this time been combined under one professor. In 1871 a special lecturer on forest formation was appointed; and from July 20th of the previous year, until the 1st May of this year, the school was closed in consequence of the Franco-German War, many of the students being required to take up arms. An important further development of the work of the academy took place in 1872, by the organisation of five departments for carrying on researches in forest technology—chemistry and physics, meteorology, plant physiology, and zoology—all conducted by the professors connected with the academy. In 1873 the increasing number of students, as well as accommodation for the various researches and collections, rendered the erection of new buildings necessary, and a commencement was made with the present buildings, which were finished in 1876. In this year also important alterations were made in respect to the admittance of students,

[1] "Die Forstakademie Eberswalde vom 1830 bis 1880" (B. Danckelmann).

which are still in force. In 1874 a lecturer on forest road construction, plan drawing, etc., was appointed, which brings the staff of teachers nearly up to its present strength. The establishment of a station for fish-breeding trials was brought about in 1877, when the completion of the various provisions for instruction may be said to have been accomplished. The increase in the number of students has been very gradual, the smallest number that attended during any session being three years after its removal from Berlin, when only twenty-one were attending the winter session of 1833. For the first ten years the average number for each session was only thirty-three, or five less than the attendance during the first one. During the next ten years the average for the whole time amounted to fifty-seven. At the end of 1860 it was seventy-six. The end of the next decade showed a diminution to fifty-five, these years being the period in which the Forest School at Munden was opened, resulting in the removal of many students from Eberswalde to that place. At the end of 1880 there were eighty-three attending, and at the present time one hundred and twenty (of whom thirteen are foreigners), or an increase of about eighty students since its commencement in 1830." The above figures may not be of great interest in themselves, but they serve to show what has been gradually built up from a small beginning, and may throw a little light on the long-disputed question regarding the feasibility of a Scottish school of forestry.

The present academy, finished in 1876, is a handsome red brick structure three storeys in height, having a frontage of 110 feet and a width of 85 feet. It stands immediately outside the old town, and in front of it, on the opposite side of the road, is a small piece of ground, laid out with flower-beds and shrubs, which is under the charge of the director. The old buildings (now the residence of the director, and also containing the library and bureau) stand a few yards to the left of it, while a church occupies the ground to the right, so that no incongruous erections are possible. The entrance is in the form of a portico, supported by two brick columns, to the right and left of which are the rooms occupied by the ground-officer and laboratory attendant, the remaining portion of the basement being occupied by wood and coal stores, lumber rooms, etc. A broad flight of stone steps leads up to the entrance hall, in which notices of excursions, lectures, etc., are posted up in a frame provided for the purpose. On this floor are the reading-room for the students, lecture-room for chemistry and mineralogy, experimental workroom, chemical laboratory for instruction, room for weighing, and chemical hand collection, geological hand collection, geological and chemical laboratory for researches, mineralogical workroom for the professor, and geological museum. From the entrance hall a broad flight of stairs leads up to the second floor, which, so far as arrangement goes, is a counterpart of the one below and above it. This floor contains the forestry and chase museum, geodesy and physical collections, meteorological workroom, conference and reading-room for the professors, and lecture-rooms for forest science and physics and mathematics. The top floor holds the botanical and zoological museums, lecture-rooms and workrooms for the same department, drawing-room for plan drawing. The lecture-rooms are fairly large, well-lighted rooms, with desk accommodation for about one hundred students; the lecturer's desk being placed at the end, at the back of which hangs a black board. In each lecture-room is a plan of the seats, which are ali numbered, and each student must write his name on the space representing the seat he wishes to occupy during the session, the senior students having the right of preference in regard to their choice and retention of formerly occupied seats.

The museums are of great interest and value for purposes of instruction, and are very complete. The forestry, botanical, and zoological collections are available for inspection by the students at all times; the others require special permission from the respective professors. The forestry museum occupies the whole width of the building, two rooms and a portion of the end of the passage which runs through the floor being fully occupied. It is divided into nine divisions for the sake of convenience, viz., forest construction tools; appliance and contrivances for forest protection; manipulation of wood and bark in the forest; wood transport; raw products of the forest; wood manufactured articles; utilisation of forest bye-products; forest mensuration; and the chase department. Under the first heading are arranged all the numerous tools and machines for planting and sowing, as well as for the preparation of the ground. These consist of many tools and implements that would be well worth describing if space permitted, as they are probably rarely seen outside the district in which they are used. Planting spades, rakes, ground preparers and breakers, models of ploughs and harrows specially invented for breaking up forest land, sowing machines, pruning tools, etc., are all represented, while the price of the implement is always stated on the label. The forest protection department contains models of erections for protecting young plants from frost, insects, animals, etc. The third division is rather a large one, containing the various tools used for felling timber and preparing it for sale, such as axes, saws, apparatuses for numbering felled timber, bark stripping tools, etc. The wood transport section is perhaps the most interesting of the whole, and consists principally of models of timber slides, sledges, rafts, tramways, etc., for the removal of timber from the forest, many of the specimens being models from actual erections in the Black Forest, and are very ingenious contrivances. The raw product division comes next, with specimens of the various barks and tanning materials in the raw condition, together with the smaller woods which are less frequently utilised. The wooden products occupy a considerable space, with specimens and models of almost every imaginable article that wood can be turned into, with the tools necessary for their manufacture. The seventh division, utilisation of raw products, exhibits the various ways in which seeds, etc., can be utilised; models of factories, and inventions for the extraction of tar, resin, etc.; specimens of coniferous timber tapped for resin, wood paper, peat, charcoal burning, and various other specimens and models of great interest in forest economy. The eighth division is devoted to the various instruments used in calculating the height and cubic contents of trees, and also a number of specimens and sections showing the growth at different periods in various timber species, and the results of thinning, etc. The last division is devoted to the relics of the chase, or rather its bearing on forest management, containing specimens of traps and snares used for trapping the injurious animals, and means of encouraging the useful animals and birds. Casts of the footprints of various animals are shown in plaster of Paris; and nesting boxes and other means and appliances for providing accommodation for the insectivorous birds show the great importance attached to their encouragement in German forests. In addition to these nine departments are a few cases containing specimens of the more common fungi and parasites which injure standing trees and seedlings, and also diagrams and tables setting forth the result of various experiments in transplanting and thinning. A complete catalogue of the whole collection is to be found in the museum for reference, while several other explanatory books and pamphlets are laid about here and there for providing further information. The total number of specimens in this collection is about twelve hundred.

The botanical collection consists of two divisions, one general, and the other containing specimens relating more particularly to forestry. The latter contains specimens of all the various fungi that attack dead or living trees, both in wood, bark, and leaf. Abnormal growth in trees, and the sections showing the healing of wounds after natural or artificial pruning, are numerous, and many extraordinary specimens are to be seen. The fruit and seeds of all the various trees and shrubs occupy the centre of this room, either dried or preserved in spirits. On a table beneath the window lie small sections of all the indigenous and introduced timber trees and shrubs. These sections are numbered, while the names are to be found on a card beside them, and also a large tabulated summary of their most prominent characteristics which are recognisable by the naked eye. The advantage of this system over that of naming the sections at once, is that the student is able to use his power of discrimination between the various species more easily than if the name were straight before his eyes, and thus is more likely to become acquainted with their characters. The other division of this collection occupies another room, and consists chiefly of dried specimens of the indigenous plants of Europe, together with large wax models of representative species of the chief natural orders. This room also contains a collection of dried fruits of forest trees in boxes, numbered and named in the same way as the wood sections. An adjoining room, which is used partly as a workroom by the professor, contains a valuable collection of woods in four large cases, timbers from all parts of the world being represented. A large herbarium stands in the passage of this floor, the plants being placed in boxes opening like a book, and arranged in cases in the same way as in a bookcase. Large radial sections of typical growth of the common forest trees stand in the passage of the second floor, with particulars of their age, height, and locality in which they were grown.

To the general observer, the zoological collection would probably prove the most interesting of the whole of the museum in the academy. It also occupies two rooms, and, like the botanical, contains both a general and special division. The great feature of the former is the splendid collection of European birds, which occupy the greater part of one room, and contain many rare and interesting specimens. Of equal interest to the forester is the large collection of specimens of bark and wood injured by various animals and insects. These consist both of small specimens under cases and also of larger blocks arranged round the walls, showing the characteristic way in which the insect works. Specimens illustrating the work of woodpeckers and other kindred species are also shown, and also the dust left in the galleries of wood-boring beetles, etc. The insects themselves, together with many others of less importance, are arranged in cases fixed on a revolving stand. The other part of this collection consists chiefly of forest mammals and skeletons of the same, and also a collection of horns of different species of deer. It is rather interesting to note in connection with this collection, the great number of specimens of seedlings and young trees injured by the various members of the mouse family, and by the extent of the injuries inflicted one might easily mistake them for the work of a larger animal. As in connection with the insect pest, so here also are shown the remains of seeds and fruits after their edible portions have been devoured by the animals. Specimens of hoofs and paws of the larger animals are exhibited in order that their remains may be recognised if met with in the forest, great importance being attached to everything in connection with the chase.

In the chemical and physical museum are shown the majority of the various organic and inorganic elements commonly met with, and also a small collection of metals. The physical portion consists of instruments used in various scientific observations in connection with meteorology, chemistry, electricity, and microscopy, besides various inventions for the purpose of demonstrating the laws of physics and mechanics.

The collections in connection with mineralogy and geodesy contain specimens and instruments relating to those sciences, and do not require detailing.

In the drawing-class room are several very interesting maps of forest districts, and also models in plaster of the principal mountain ranges in Germany, showing the arrangement of the forest compartments.

The library, which is placed in a portion of the old buildings, contains between five and six thousand works on all subjects connected with forest science, and also on the allied branches of agriculture and gardening. According to the catalogue of 1885, the following number of books on the various branches were present:—250 on forest and chase history; 134 text-books on forest science; 225 on forest formation and tree culture; 87 on forest protection; 167 on forest utilisation; 289 on forest valuation; 244 on forest administration; 66 on forest engineering; 291 on mathematics; 47 on natural science in general; 128 on physics; 27 on mechanics; 19 on astronomy; 148 on meteorology; 182 on chemistry; 395 on geology; 376 on political economy; 251 on agriculture, gardening, etc.; 380 on botany; 293 on zoology; 456 on law; 353 on geography; 194 on the chase; 198 copies of reports, periodicals, etc.; and 156 miscellaneous works. It is open on two days in the week for the taking out and return of books, the numbers of those required having to be written on a piece of paper, and dropped into a box provided for the purpose.

The forest garden, as it is called, is about half a mile from the academy, and is in reality part of the Eberswalde forest. It contains about 15 acres, the greater part of which is under fir and beech forest, the introduced species being planted in clumps here and there, with rustic fencing round them for protection. At the back of the seed-kiln is a large nursery for raising the plants required, and the shooting ranges for the use of the students are also here. This nursery is partly taken up by clumps of various coniferæ, which are never mixed with each other, but always kept in separate clumps, so that their behaviour under ordinary forest conditions may be observed. A smaller nursery for raising the ordinary forest trees also exists a few yards from this one, and which contains high spruce hedges along both sides of the walks.

The botanical garden, which is placed on the margin of the forest garden, and forms part of the latter, is about three acres in extent, and is bounded on the lower side by the small stream which flows through Eberswalde. In outline it is somewhat oval, while the surface in the centre is high and undulating, and on the right and left sides low and flat, so that it presents a great variety of surface for treatment. About the centre stands a handsome granite column, surmounted by a white marble cross, erected in 1873 to the memory of those forest officers and former students of the academy who fell or died of wounds in the wars of 1864-66 and 1870-71, twenty-one names in all being inscribed upon it. At the lower side of the garden a clump of beech and Scots fir provide suitable accommodation for a rustic summer-house, while on the ground beneath the trees are planted numerous shade-loving and herbaceous plants natives of the forest. The undulating portion in the centre is laid out in irregularly-shaped beds, which are bordered with neatly trimmed spruce hedges, between which are dry gravel walks. In these beds are arranged the different species of the smaller genera of forest trees and shrubs, and also the majority of the coniferæ, the lower lying portion of the garden not being suitable for the healthy growth of the latter. Each bed contains one or two complete genera, which are planted sufficiently wide apart to allow their natural habit to be seen, the larger species occupying the centre, and the smaller the margins of the beds. The surface between the plants is kept neatly raked or planted with annuals or herbaceous plants. The names are painted in legible black letters on white porcelain tablets, which are affixed to stout wooden pegs. To the right and left of this central portion the ground is laid out in grass, and is of rather a peaty nature, the central portion being sandy. The left-hand portion is intersected with gravel walks, between which the larger deciduous genera have been planted, while a number of the specimens of the spruce family are also planted here. The right-hand side is not yet laid out, except the portion occupied by the collection of willows at the lower side, and a few beds of herbaceous plants. Altogether this garden has been laid out in a highly pleasing manner, and contains a very complete collection of plants, and thoroughly well accomplishes the purpose for which it was intended. The plants throughout are very healthy, and appear likely to produce good specimens in time, although they have not as yet had time to reach a great size.

On the high ground above the town is the Meteorological Station, which stands in a thick part of the Scots fir forest. It is one of thirteen stations distributed over Prussia, and which are placed in either spruce, pine, or beech forests. The Eberswalde station stands about 140 feet above sea-level, and on a dry sandy soil, and consists of two sets of instruments, one in the forest, and the other set about 100 yards from the margin of the forest, on an open, freely exposed piece of ground, the two sets being about 300 yards distant from each other. They are both enclosed by strong wooden fences, and contain complete sets of instruments for observations on the temperature of the air, moisture, rainfall, evaporation, temperature of the soil at six different depths, direction and strength of the wind, amount of shade and sunshine, etc., both in and outside the forest, and other special meteorological events. The observations are under the direction of the professor of physics, and are published at regular periods. In the forest station observations are also made at a height of about 50 feet from the ground by means of a stand nailed to the trees, access to which is obtained by means of a set of ladders nailed from tree to tree. Each enclosure also contains a small office for making the necessary entries on the spot, the principal work being carried on in a room provided for the purpose in the academy.

A small fish-hatching station has been erected about an hour's walk from the academy, in a portion of the Eberswalde forest, in which artificial trout-breeding is carried on, while several small ponds in the vicinity are stocked with trout and carp.

A small vegetating house at the back of the academy is used for experiments in connection with the botanical and soil analytical departments, the mentioning of which brings the description of the academy's subsidiary belongings to a close.

As may be expected, the forests in the vicinity are very extensive, and afford a wide field for excursions and instruction. The Oberforstereien specially made use of for purposes of instruction are four in number, viz., Eberswalde, Biesenthal, Chroin, and Trienwalde. The two former adjoin, and lie to the south and east of the town, Chroin lies to the north-east, while Trienwalde lies at a considerable distance to the south-east. The three former are intersected by the railway between Stettin and Berlin, while the last-named is also connected with Eberswalde by a branch line, so that every facility is afforded for reaching their farthest limits without loss of time. Other extensive forests lie within a short distance, so that no lack of material for observation exists in any direction. The total area of the three Oberforstereien in the immediate vicinity is about 40,000 acres, the greater part of which is under Scots fir forest, although large areas are also under beech and oak, while much of the better class of soil is gradually being converted into permanent beech or oak forest by underplanting or undersowing the fir. The surface of the Eberswalde and Biesenthal portion is flat or only slightly undulating, while the other parts are generally hilly, and contain a greater variety of localities. The greater part of the soil in all four is sand, and nothing but sand, although numerous beds of clay, marl, etc., exist here and there over the whole, and much of the low-lying land is peaty. The chief feature of the district is the number of large lakes which occur in the hollows, several of which are over 100 acres in extent, and form noteworthy objects in the landscape. The forests are under the control of the director of the academy, while the principal forest officers are lecturers in the same, so that both the working and arrangements for excursions are made as complete as possible.

In the Chroin Oberforsterei is a large nursery in which plants and trees are raised for sale, and for the requirements of the forest. Large quantities of trees for road-side planting are also grown here, the practice of rendering the highways more agreeable to travellers, and at the same time a source of profit, being one which might be extended to our own country with advantage. The false acacia (*Robinia pseudo-acacia*) is largely used for this purpose, its moderate size and prickly nature rendering it especially suitable for furnishing a medium shade, while a more ornamental tree could scarcely be found. Adjoining this nursery are the ruins of a large Cistercian monastery, built in the purest Gothic style, and existing in a fair state of preservation.

Numerous experiments are being carried out in these forests with the various introduced coniferæ and deciduous trees. These are planted in enclosures of about 5 or 6 acres in extent, and are both planted alone and mixed with other species. The Douglas fir appears likely to thrive remarkably well here, judging from its appearance at present, although it must be said that it is no exception to the other species in this respect, for the poor character of the soil appears to be balanced by its great depth and free nature, which allows root development to proceed unchecked. It is rather surprising that larch has not been more extensively planted here in the past, as from what can be gathered by the appearance of the few clumps that are to be seen occasionally, the soil appears to suit it remarkably well. It is, however, being gradually introduced into the recent sowings and plantings, and the Weymouth pine and the various American spruces are also being tried.

The district contains a very rich forest flora and fauna, and a wide field exists for botanical and zoological excursions. Roedeer, wild swine, and reddeer are the chief features in the sportsman's line, and hares are also rather numerous. Rabbits are conspicuous by their absence. Squirrels are very numerous, but appear to do little damage to the Scots fir here, probably owing to the abundance of beech and hornbeam, which provide them with plenty of more attractive food. Birds are very numerous, and many fine specimens of the larger woodpeckers are to be seen by the observer. Insects of all kinds, injurious and harmless, abound everywhere, although the natural condition and proportions in which bird and insect life are maintained, prevent any great damage being done by the latter. Both for their preservation, and also to prevent damage to the trees, the deer are provided with hay in very severe winters in the vicinity of the recently planted ground, although it is rare to see any damage done to the Scots fir, the hardwoods being the principal sufferers.

The Subjects on which Lectures are given, and Hours per Week devoted to each, over a Two Years' Course of Instruction at the Forest Academy, Eberswalde, are as follows:—

First Year.			Second Year.		
Subjects.	Summer.	Winter.	Subjects.	Summer.	Winter.
Physics,	4	...	Analytical Geometry,	...	2
Mechanics,	2	...	Soils,	2	...
Chemistry (General),	2	...	Comparative value of important trees in forest formation,	...	1
,, (Inorganic and Organic),	...	4			
Mineralogy,	2	...	Forest Valuation,	1	...
Botany,	4	...	,, Ground Rent,	2	...
Zoology,	5	...	,, Protection,	3	...
Forest Formation,	...	4	,, Utilisation,	...	3
Civil Law,	2	...	,, History,	...	2
Meteorology,	...	1	,, Statistics,	...	1
Wood Measuring,	...	2	,, Plan Drawing,	2	...
Geodesy,	...	4	Redemption of Forest Ground Rights,	2	...
Geology,	...	2			
Anatomy and Physiology of Plants,	...	4	Repetitoriums over Physics, Mathematics, Chemistry, Botany, Zoology, and Forestry,	4	3
Microscopic Demonstration,	...	2			
Plan Drawing,	2	...			
Total per Week,	23	23	Total per Week,	16	12

Excursions take place on three days in the week during the summer session of first year, and on four days during the summer session of second year, in connection with forestry, botany, and zoology. During the winter sessions, on two days in the week, in connection with forestry only.

The teaching staff at the academy at the present time consists of thirteen professors and lecturers, in addition to the director. These comprise professors of physics, mineralogy and geology, chemistry, botany, and zoology, four forstmeisters as lecturers on forestal subjects, a lecturer on civil law, and two private lecturers, one on zoology and the other on field engineering. As already mentioned, the forstmeisters have duties to perform in connection with the surrounding Oberforstereien, but, generally speaking, the greater part of their time is free for instruction purposes, or for the various researches which are carried on both by the practical and scientific departments of the academy, and which have resulted in many valuable and interesting reports.[1] As indicating the nature of these researches, the following may be cited as specimens of those carried out in the practical departments :—

On the raising of seedling plants, quantities of seed required for given areas, preparation of the seed, and effects of transplanting on the growth of the plants.

On the depth of the earth-covering of seeds.

Trials of planting tools, seed-sowing machines, etc.

Trials of germinators.

On the thinning of oak, beech, Scots fir, and spruce forests.

On pruning forest trees.

On the behaviour and value of Douglas fir in the German forests.

On the grubbing and removal of tree roots.

On the comparative value of saws.

On the yield of oak and beech seed.

On the height growth of different species.

On the proportion of branches to stem at different ages and periods of the year, etc., etc.

The other experiments in connection with the scientific side are of an equally important nature, and all tend to show the great value of the work carried on at the institution in connection with forest science in all its various branches.

In addition to his other duties, the director also edits a forestry periodical, which is issued monthly, and usually contains contributions from the various professors and others outside the teaching staff. In his clerical duties he has the assistance of two clerks, one of whom acts as librarian. A conference is held weekly by the director and professors for the purpose of making arrangements and necessary alterations in connection with the instruction, and other business matters. At the commencement of every session a plan of study and lectures is drawn up by the director after consultation with his colleagues, and printed copies posted up in the lecture-rooms, etc. This plan includes two courses, in order to meet the requirements and convenience of those students who enter

[1] In this work they have the assistance of seven forest assessors, who are employed chiefly in attending to the details of the experiments, and keeping the necessary records.

the academy in different years, and also to prevent the lectures overlapping. A student who wishes to do so may, however, take up any subject he chooses, independently of this plan, although those who intend to take a full course must follow it to a certain extent, otherwise they will be unable to finish their studies within the prescribed time. The average number of hours per day spent in the lecture-rooms are not more than five for the five days in the week on which lectures are given, and these are almost entirely confined to the morning in the summer session, a commencement being made at 7 A.M. A lecture which occupies more than one hour is always divided into two parts, by a break of a quarter of an hour in the middle, in order to prevent any weariness or inattention resulting from a long sitting. Great importance is attached to "repetitoriums," in which the ground of former lectures is glanced rapidly over, bringing out the most important points in the various subjects. These are given frequently during the second part of the course, so that the student may be kept up to the mark in everything from the beginning.

The afternoons of two days in the week, and the whole of the Saturday, are devoted to excursions during the summer session, while for the students of the second course, the Wednesday also is taken up in this way. In the winter session excursions only take place on the Wednesday and Saturday. These excursions rarely occupy more than half a day, the forestry excursions being of course the longest and farthest afield. They are duly notified in the hall of the academy some few hours or days beforehand, the time and place of rendezvous and also the theme being given. The lecturer there meets the students, and a lecture lasting the best part of an hour is given if the subject is in connection with any special work or sylvicultural system, in order to explain its adoption and the conditions under which it must be modified. In the case of practical work, such as sowing or planting, the cost of the work under different methods is stated, and the older students are usually invited to show their proficiency in the work. Sometimes the excursions are of a more rambling character, and several miles have to be traversed in order to demonstrate the subject in different parts of the forest, anything met with on the way that calls for any special notice being duly observed and commented upon. At every excursion a reporter is selected from among the students, who is obliged to draw up a complete report of the excursion and the explanation given, so far as they relate to the theme. These reports are passed by the director, and are then pasted into a book placed in the reading-room of the academy, and prove of great value for reference, as well as for furnishing information to the students of the other course, the two courses having each a set of excursions distinct from each other, the first course excursions being of a more elementary character than those of the second. Frequent visits to the botanic garden are also made during the summer session under the professors of botany, when the various trees and shrubs are in flower, and their different characteristics pointed out, or a number of specimens may be laid down with numbers attached, and the students required to write down the names in their note-books, the professors afterwards reading out the names.[1]

The course of study at the academy extends over two years, or four sessions, beyond which a student is not allowed to remain, except under exceptional circumstances. The summer session begins at Easter and finishes at the latter end of August. The winter session begins in October and finishes a fortnight before Easter, a week at Whitsuntide and Christmas being the only inter-sessional holidays allowed. The instruction given in these two years is very comprehensive, and includes subjects in the fundamental, technical, and accessory branches. Under the first-named are comprised physics, meteorology and mechanics, chemistry, mineralogy and geology, botany, zoology, and mathematics. The technical subjects taken up are the history and literature of forests, position of forestry in political and rural economy, regeneration of forests, preservation and utilisation of forests and forest produce, forest mensuration and valuation, forest statistics, forest politics and administration, and redemption of forest ground rights. The accessory are civil law, forest roads and timber transport, the chase and fish-breeding. The fundamental and accessory subjects are not gone into further than their bearing on forestry necessitates, while much of the former division has been imparted to the student in a general way before he reaches the academy.

The conditions under which candidates for the State service are admitted to the academy are fairly strict, but are not connected

[1] In addition to these local excursions, a more protracted one, lasting about a fortnight, is undertaken at the close of the summer session of every alternate year, the locality chosen being one in which different methods of culture and varieties of soil exist which are not represented in the vicinity of the academy.

with competitive examinations. The candidate must possess certificates of having passed satisfactorily through a gymnasium or high school under the control of the State, and special proficiency must have been shown by him in mathematics. He must have served an apprenticeship of at least one year under a State forester, and show the necessary certificates of the same. He must have led a blameless and strictly moral life, and possess medical testimony in regard to his physical soundness and constitution. He must not be above twenty-five years of age at the time his studies at the academy begin. He must furnish proof of his possession of sufficient means to bear the necessary expenses of his course at the academy. And further, he must have already passed a session or so at some university, have served his term of military service, and, in addition to his apprenticeship, have passed a certain time in the forests employed in the various work connected with wood-measuring, surveying, levelling, etc., special importance being attached to the two latter subjects. He may either go through the whole course at the academy, or he may spend one year at Eberswalde and the other at Munden, the plan of instruction at both academies being so adjusted as to render this course available without great inconvenience, and is recommended by the authorities, as, although the theoretical and scientific instruction is practically the same at both, the different districts in which they are situated furnish a variety of practical work and methods for the excursions. After the necessary certificates, etc., have been produced by the candidate, he receives a matriculation ticket from the director, which he is required to carry about with him at all times, and to produce if necessary. This ticket must be given up again before the student leaves the academy, and if he should happen to lose it, must apply for a fresh one at once. At the commencement of his studies he has also to fill in a form with the subjects he intends to take up during the session, which must then be signed by the respective professors both at the commencement and end of the session or course, the date on which the respective signatures were made being also entered. This form takes the place of a roll-call, the regular attendance being left to the student's common sense.[1]

[1] The matriculation fee for State candidates and all others intending to take the full course is fifteen marks, while the fees for the whole lectures are seventy-five marks each session, or less if only a portion of the lectures are taken. Hospitanten who are admitted to the academy pay a matriculation

The students find their own lodgings in the town, but are obliged to conform to the rules of the academy drawn up for their control by the director, although they are rather precautionary than intended for strict observance. He must notify his address to the director within twenty-four hours after receiving his matriculation card, and this address is inserted in a list opposite his name, which lies in the reading-room. The life of the forest student is in almost every respect similar to that led at any of our Scottish universities, and is, generally speaking, a very pleasant one. The majority wear the forest uniform, consisting of light green tunic and trousers and dark green peaked cap, but its adoption is quite optional, and must be provided at the student's expense.

At the expiration of the two years' course at the academy the candidate has another session to pass at some university before being allowed to stand for the first forestal examination which takes place at the academy, and embraces the majority of the subjects in which instruction has been given. It is held by a special commission appointed by the Minister of Agriculture, and is both written and oral, and also practical, the latter taking place in the forest. The passing of this examination ranks the candidate as a "Forest referendar," and in the event of his failing to pass, he is allowed to come up again the following year, but if failing to pass within two years after the first attempt, he is excluded from further probation. Before being admitted to this examination, he has also to produce a special plan of not less than 100 hectares of forest, a working plan of 500 hectares, and a lineal section 2 kilometres in length, all prepared by himself without assistance. The next move that he is obliged to make is to get himself placed under a State forester for two years further practice. The first six months of this period are passed in the performance of all the duties connected with the practical management and superintendence of forest operations, under the direction of the Oberforster of the division he is in. The next five months are passed in the same division; but during this period he has complete control over the superintendence, and receives no assistance from, and is not interfered with by, the Oberforster, unless exceptional causes for such arise. The succeeding four months are passed in work

fee of ten marks for every session, and the same fees for the lectures as the other students. These fees are paid into the academy bureau, the professors having nothing whatever to do with them, either directly or as a portion of their salaries.

connected with the higher branches of forest administration, as the preparation of working plans, valuations, etc. The remaining period of his training is passed under different Oberforsters in the same sort of work, and he is then, seven years after commencing his forestal training, allowed to stand for the State examination, after passing which he becomes "Forest assessor," and practically enters the forest service as a salaried officer. During his last two years' probation he must keep a diary of his daily work and occupation, noting the division which he was in, and also any special incident that came under his observation. This diary must be inspected and signed by the Oberforster before he leaves his district, and must be produced at the final examination.

In addition to the above ordinary course of entering the forest service are two others connected with service in the Feld and Foot-Jager Corps. The former course involves a seven years' service in the Feld-Jager Corps after the yearly apprenticeship in the forest, the corps being stationed in the town of Eberswalde, so that the necessary facilities for receiving the instruction at the academy are present. The members are provided with free quarters and firing, their other necessities they must furnish themselves, the ability to do which they must furnish proof of before their admission to the corps. In the case of the Foot-Jager the military service is shorter, and the conditions somewhat different, but in both cases the service, or part of it, counts as student time in qualifying for the examinations, the latter being the same in all three cases.

Such is a brief outline of the training to which the aspirant for forest service in Prussia is subjected, and it is rather surprising that so many are found willing to pass through it, in consideration of the comparatively small remuneration given at the end of it. The advantages are, however, greater than would appear at first sight. In the first place, the life of the forest officer is not one of very severe work, either physically or mentally, and has many attractions for a lover of sport. Everything in connection with the administrative duties are all cut and dried, it may almost be said, years beforehand, while the formulæ for the necessary revisions and alterations in the working plans, etc., have been well instilled into him during his long training. He has the results of centuries of observation and research at his finger ends, and scarcely a contingency can arise but what he has already been warned of its liability to occur. When he takes charge of a division he finds everything in the same order in which he is expected to leave it, and he is not handicapped during the first few years by having to make up and overtake arrears of work, etc.

The life may appear monotonous, and probably would be to one with no taste for the profession, but the conditions under which he enters the service render this almost impossible, as unless he has considerable interest in his work, the acquirement of the knowledge necessary in order to pass the examinations is almost too great a task to be undertaken. The training of the forest officer is of such a nature as to develop his powers of observation to the utmost, and his acquaintance with the habits and life-histories of the various birds, insects, etc., and their bearing on his profession, tends to occupy his mind in a manner quite unknown to the ordinary individual.

That such a thorough training is absolutely necessary is a matter of opinion, but the results which have followed it tend to prove that it is not thrown away. At first sight there is nothing remarkably striking in German forests to lead one to suppose that they are managed on the scientific principles that they are, but when the detail with which they are worked is once understood, and the minute researches which have been carried out in every branch of the science, it must be admitted that little has been left undone that the most exacting could desire.

XVII. *Trees Best Adapted for Various Soils.* By A. D. Webster, Hollydale, Keston, Kent.

There is, perhaps, no soil so bad or barren that may not be rendered profitable by judicious tree-planting; but, as might be expected, there is often a great want of knowledge as to the proper kind of trees to be chosen to suit a particular soil. Where the plantations are intended mainly for profit, grouping of the trees according to soil and situation will be found the surest method of attaining such an end.

In looking over a large extent of woodland one will generally be struck with the great disproportion in size of the individual trees of a species; but it will generally be noticed that where the largest and healthiest occur the tree is usually growing upon its own soil, and is found to be flourishing at the expense of all around it.

Thus the finest oaks will be found where the soil is deep and loamy, resting on clay; beech upon a calcareous gravel, resting on a bed of chalk; ash and elm on a dampish loamy gravel; birch in a light black loam, with a gravelly substratum; Spanish chestnut in a good loamy soil, not too damp; the mountain ash at a good elevation, in a rather light soil; horse-chestnut in deep loam, dry at the bottom; the Scots and Corsican pines, *Pinus sylvestris* and *P. Laricio,* at fairly high altitudes, and in gravelly well-drained soils; and the Cluster and Aleppo pines (*P. Pinaster* and *P. halepensis*) in almost pure sand on the sea-coast.

Some trees grow rapidly enough for a few years in almost any soil, but after a time they gradually show signs of distress, make little or no progress, and ultimately become stunted and ill-grown; or, should the soil be very unfavourable, they die outright. Instances of such are unfortunately far too common wherever one travels over the country, trees of a kind that are utterly unfitted for the particular class of soil being planted in a kind of haphazard way, and without any consideration of their individual requirements.

For all practical purposes with reference to tree culture, soils, generally speaking, may be divided into six distinct classes—peaty, chalky or limey, gravelly, clayey, loamy, and such as contain ironstone, coal, etc.,—and so as to render the subject as concise as possible we will treat each soil separately, giving a list of the trees best suited for growing thereon.

Peat.—Few trees will succeed well on an unreclaimed peat bog, but where draining and soiling have been attended to at the outset, the numbers that grow and produce a fair amount of valuable timber are almost without limit among our generally cultivated trees. On recently examining several large plantations that were formed eighteen years ago on deep peat, on an estate in Ulster within a few miles of Lough Neagh, a useful lesson was learnt as to the best trees for planting on this kind of soil. Previous to being planted, the peat was generally of the kind which is largely used for fuel in Ireland, deep, damp, and in some places almost a quagmire, yielding to the tread, and unsafe to stand upon. A wide and deep ditch was opened along the lowest part of the ground, and smaller drains run at nearly right angles to the main, usually in the damper places where they were most required. This was carried out fully a year before planting, and it had a decided effect in consolidating the ground for pitting in the following autumn. In summer the heath, in many places fully a yard in length, was closely burned. Pits, about 18 inches square and nearly as deep, were then opened at 3 feet apart, and left exposed to the frost during the winter. The following March and April soiling and planting were carried on at the same time. The soil used was rather stiff clayey loam brought from some distance, spadefuls of which were incorporated with the peat previous to filling the hole.

The cost of preparing the ground before planting is apart from the subject of this paper, suffice it then to say that the results thus obtained warrant the recommending of such a method in connection with this class of soil.

Among conifers that have proved themselves suitable for bog-planting are the Larch, Scots Pine, Common and Black Spruces (*Abies excelsa* and *A. nigra*). The Larch grows rapidly, and is perfectly free from disease; indeed, I cannot remember having seen a trace of any of the diseases which have rendered the larch so precarious a tree in this country. In thinning a larch plantation of fully sixty years' growth I found the trees felled to be perfectly healthy, and of exceptional quality, with on an average 72 feet of wood in each. The subsoil was clay, and the bog previous to being planted had been cut over for fuel. Drainage and soiling of the pits had been duly attended to. In young larch plantations on deep peat bog, previously drained and soiled in the way above described, I have found the cubic contents to be fully $2\frac{1}{4}$ feet in eighteen years. The Scots pine grows almost as fast as the larch—the average in over fifty trees measured being about an eighth less—under similar conditions.

Natural reproduction of the Scots pine goes on so rapidly on peat bog that it must be considered one of the very best trees for planting on it. As an example of this I may state that five acres of partially drained peat bog on the side of a large lake in Ireland is now quite clothed with a thriving crop of self-sown Scots fir, the seeds being carried from a clump of old trees growing at a short distance away. Seeing how well the young trees were thriving, principally along the edge of the drains, I had all the damper portions of the ground thoroughly drained, with the result being that there is now a healthy crop of fast-growing trees all over the ground. In order, however, to avoid bare patches, I had a few young trees notched in here and there wherever gaps occurred. I am quite aware that the wood of Scots fir is of less value than that of the larch, but my object here is to point out the most suitable trees for growing on the soil under consideration. The Spruces are excellent trees for planting on reclaimed peat bog, where they produce a fair amount of timber, and afford excellent shelter to other trees.

Of hardwoods, the Beech is one of the best for bog planting, as it grows rapidly and produces a great amount of clean timber. Several trees felled in thinning a plantation of sixty years' growth on deep peat, resting on clay, had straight, clean stems for 30 feet, and contained 75 feet of timber. The Alder grows luxuriantly on peaty soils, and in the plantation with the beeches just referred to, the greater portion of the trees were 60 feet in height, girthed 5 feet at a yard from the ground, and showed no trace of disease. Another excellent bog tree is the Cherry, and the same may be said of the Holly. Ash and Oak are not generally of large size, nor are they always healthy on peat bog, even when it has received a great amount of attention in reclaiming. Birch, Lime, and Poplar of various kinds are all suited for planting on well-drained peat.

Among the newer conifers, a large number of them are well suited for planting in reclaimed peat bog. By way of experiment, I have planted specimens of various kinds in newly formed plantations, and in nearly every case the trees have grown well, particularly when partially sheltered. *Cupressus macrocarpa* is one of the best, and not a whit behind it are *C. Lawsoniana* and *C. Goveniana.* *Wellingtonia gigantea* and *Sequoia sempervirens* have done well, while *Pinus Laricio* and *P. austriaca* grow freely. I find that a large number of the recently introduced conifers do well on prepared peat bog—that is, where a quantity of loam has been incorporated with the bog, and all superfluous moisture drained away.

Chalky Soils.—The Beech is peculiarly well suited for planting in chalk districts, for it will grow and produce a large quantity of timber where but a few inches of loam overlie the chalk—a fact exemplified in Holwood Park, Kent, where trees containing fully 200 cubic feet of wood, with stems girthing over 20 feet, may be seen. It is a fact that, in order to find where the chalk beds lie, one has only to be guided by the line traced out by the largest and most luxuriant beeches. As to planting the beech on pure chalk, or where no surface soil exists, I would not think of doing so, at least if the production of timber was of importance. The beech will no doubt grow on pure chalk; but where we have noticed it doing best is where loam, from 1 foot to 3 feet in depth, overlies the chalk, or is incorporated with it. In several instances that have come under my notice lately in stubbing out old field boundaries, this was the only hardwood tree that had attained to a respectable size of the many natural or planted kinds; but in some parts the chalk cropped through, while no part had more than 3 or 4 inches of loam or clay overlying the chalk.

The Norway Maple (*Acer platanoides*) revels in a chalky soil, and so does *A. colchicum rubrum*, which are both handsome, hardy, large-growing trees, and well suited for extensive forest planting under certain conditions of soil. White Poplar (*Populus alba*) is an excellent tree for planting in chalky districts—indeed it is surprising to see to what an immense size it attains on almost pure chalk. Where but little soil covers the chalk, however, it does not attain to so large dimensions as where there is a depth of 2 feet or so; but it will grow to a fair size even on the hard, dry chalk, where a particle of soil is scarcely seen. Other poplars that do almost equally well on the chalk formation are *P. monilifera* and *P. canadensis*, both excellent free-growing trees. Elms, particularly the Huntingdon and the American, grow rapidly, and attain to a large size, where but a small quantity of loam is present in the chalk. The Wych elm grows freely in chalky districts, and I was surprised, some days ago, to notice it growing on the side of a chalk pit in only 7 inches of gravelly loam. The Lime grows very freely, and attains to large size, where chalk abounds in the soil. False Acacia (*Robinia Pseudacacia*) is an excellent tree for chalky soils, and there attains a greater size than on almost the richest of loams. The alder and birch also thrive with vigour on chalky soils. Indeed, most trees which in a state of nature grow in damp or marshy soils are well suited for planting where chalk is the main component of the soil, and this is explained as follows:—Chalk, although sufficiently porous to allow water to percolate through it, has, like all other calcareous matter, a strong attraction for water, and acts like a sponge in holding it in considerable quantity for a very long time. The alder is very largely grown in the southern counties, particularly in Kent, for hop poles, and I have been surprised at its luxuriant growth on the warm chalk.

Among the conifers that are suitable for chalky soils the Spanish Fir (*Abies Pinsapo*) is one of the best. In the chalky districts of Kent it thrives with unusual luxuriance. At the Rookery, near the village of Downe, we were shown, the other day, some of the largest trees of the Spanish fir that we have ever seen. The largest was fully 60 feet in height, with a beautifully rounded tapering stem, girthing at 3 feet and 5 feet from the ground 7 feet 10 inches and 7 feet respectively. From base to tip this symmetrical tree is thickly furnished with branches, whose diameter of spread where they sweep the greensward is exactly 35 feet. The bole contains 69 feet of timber. When we consider that the Spanish fir was only introduced in 1839, or little over fifty years ago, it must be admitted that the specimen whose dimensions we have just recorded has made no bad use of its time. The upward rate of growth has been about 15 inches annually, assuming it was planted in the year it was introduced, and the annual increment of wood fully 1 foot 3 inches. The soil on which this fine tree is growing is a sandy loam mingled with chalk, resting on pure chalk, while the situation is fully exposed to the worst winds of the district. Not a hundred yards from this specimen grows another of almost similar dimensions, the bole of which girths 5 feet 11 inches at 3 feet up, while the branches cover a diameter of nearly 30 feet. The same bright, healthy look characterises both trees, while the luxuriant foliage, particularly of the latter, quite hides the stem from view. In various other Kentish gardens, where only a few inches of loam overlie the chalk, I have noticed how rapidly the Spanish fir grows, and how healthy and bright is the abundantly produced foliage. In districts with not a particle of lime in the soil I have noticed this fir thriving well; but, in comparison with those growing on warm chalk or limestone soils, the differences are markedly in favour of the latter. The Mount Enos Fir (*Abies cephalonica*) is well adapted for growing in chalky districts. In some places where it is of unusually robust growth, the soil is little else than pure chalk, with a small admixture of loam or vegetable matter, but yet its appearance and vigorous growth are such as betoken perfect health. The number of evergreen trees that succeed on chalky soil is well known to be limited, and it is important that two such beautiful conifers as the Spanish and Mount Enos firs should there find their most congenial home.

The Weymouth Pine (*Pinus Strobus*) has been recommended as a suitable tree for calcareous soils, which I can corroborate, for on the chalky downs of Kent and Surrey it grows with great vigour, if partially sheltered from cold, cutting winds. The Scots pine ranks high as a tree for planting in chalky soils. Near the chalk pits at Downe, in Kent, grows a noble clump of the Scots pine. I have never seen a better example of the "survival of the fittest" than is here presented, for, nature being allowed her freedom, the strongest trees are gradually exterminating the weaker. But this is not all, for by such a course of natural treatment clean, straight, and almost branchless trees are produced, which, when compared with such as have been allowed room to develop their side branches, are vastly superior in economic value. This clump of Scots pine is growing on a bed of chalk, with only a small quantity of loam on the surface.

The Giant Arbor-Vitæ (*Thuja gigantea*) is peculiarly well suited for planting in chalky soils. This beautiful, quick-growing, and valuable timber tree is fast coming to the front for forest purposes, and it is often found difficult to meet the ever-increasing demand for young plants. The American Arbor-Vitæ (*T. occidentalis*) also does well when planted on chalky soils, if not too dry. For forming a screen this tree is admirably adapted; but for timber or ornamental purposes we cannot say much in its favour. The Cedar of Lebanon (*Cedrus Libani*) is a first-class tree for the chalk, for finer trees than those at Goodwood, in Sussex, could not be seen; and equally fine are those at Wargrave, in Berkshire, where only a thin layer of soil overlies the chalk. The

Wellingtonia (*Sequoia gigantea*) is also an excellent tree for chalky soils, in which it grows with great vigour and a very healthy appearance.

Gravelly and Sandy Soils.—The Corsican pine is an excellent tree for planting on gravelly soils, and some of the finest specimens in this country are found at Penrhyn Castle, in North Wales, where it grows quickly to a large size in shingly gravel, and the timber produced in such a soil is of good quality. Some years ago several trees of this kind were felled, and the timber used for various purposes on the estate with the most satisfactory results. I have always noticed its preference for deep gravelly soil, or that of a loose porous nature. One of the trees referred to, growing on such soil, had attained a height of 60 feet in thirty-four years, while the butt end was 32 inches in diameter, and at 9 feet it girthed 6 feet 2 inches. The butt was free of branches for 18 feet, and straight as an arrow, and contained exactly 40 cubic feet. This fine tree was growing on the margin of a disused gravel pit, with hardly 3 inches of decomposed vegetable matter on the surface. Other examples of an almost similar kind might be given, but sufficient has been said to prove that the Corsican pine is peculiarly suitable for planting on pure gravel. The Scots pine on poor thin gravelly soils reproduces itself so freely from seed, and grows with such vigour, that it may be considered an extra well-suited tree for the afforesting of thin gravelly commons and similar tracts of land. The Pinaster, or Cluster Pine, is a most valuable tree for planting either in sand or gravel, as its growth in these in many parts of the country clearly points out. The great value of this tree in reclaiming sandy tracts, both at home and abroad, has been so often described that further reference here is not required. The Aleppo pine is a good companion to the Pinaster, and grows with greatest freedom in a sandy or gravelly soil, within the influence of the sea. Gravelly soil also suits the Weymouth pine well, for we have it growing to a large size, and looking well upon it here. Judging from the specimens we have cut up, the timber appears to be of excellent quality, and largely impregnated with resin.

Beech and oak both produce a fair quantity of timber on poor gravelly soil. The former in particular grows here with unusual freedom on rough gravelly soil, where hardly half a foot of loam overlies the gravel. To the south of Holwood House, in Kent, are numbers of large beech trees growing on a deep bed of gravel, overtopped by a few inches of yellow loam.

Clay Soil.—The soil here referred to was genuine clay, entirely devoid of stones, and without a particle of sand or loam in it. It occurred on the slopes, and for some considerable distance from the sides, of one of the park roads on an estate in England; and as the drive was likely to be largely used by the owner of the property, the getting up of shelter and an ornamental fringe at the same time, was a matter of much importance. Pits were dug, and the soil taken out was thrown loosely up for about a month previous to planting. No fresh soil was added at time of planting. Nearly fifty kinds of trees and shrubs were used, but out of all these only about half-a-dozen are doing well, the others having gradually died out, or become so rusty and miserable-looking that their removal was compulsory. First among the trees that have succeeded is the Giant Arbor-Vitæ, which seems to revel in what is generally considered the most unkindly of soils. For some years after being planted the annual shoots measured 15 inches in length, and the only difference between these trees and others of the same kind planted on rich alluvial deposit was the rather paler hue of the foliage. The branches and foliage were plentifully produced, while the stems were as straight and clean as could be desired. Even at the present time, after being planted fourteen years, all the specimens are in excellent health, and seem quite at home on their exposed and clayey site. *Cryptomeria japonica* has likewise done well; but there were not half so many planted of it as of the Arbor-Vitæ. The trees are hardly so tall as might be expected, from the number of years they have been planted; but they are bushy and well-furnished specimens. In colour of foliage these *Cryptomerias* are not so intense a green as others growing under more favourable conditions. *Cupressus macrocarpa* has done fairly well on the clay; the growth certainly has not been rapid, but for all that the general appearance of the tree is the reverse of what one might expect from the unfavourable nature of the soil. Generally speaking, the trees of this kind are bushy and picturesque, and with bright healthy foliage. The Indian Cedar (*Cedrus Deodara*) we have found to be peculiarly well suited for planting on a clay soil. Not only is the bright silvery tint, that is so characteristic of this cedar when well grown, discernible in these clay-grown specimens, but the rate of growth is fairly rapid, and the drooping branchlets are shown off to perfection. *Pinus austriaca* has in a few instances where strong plants were used done remarkably well, the foliage being of the usual dark yew-green, and the trees well clothed with branches down to the ground.

Between the groups of trees were planted clumps of ornamental shrubs, and the best of these is the double-flowered gorse (*Ulex europæa flore pleno*). On pure clay it has grown and increased as freely as it will on a dry chalky bank, which is usually considered as its natural element.

These may be considered as the trees that have done best in the clayey soil under notice; a few others still exist, but their present appearance causes me to exclude them from this list. Few of the Pine tribe did well, and this may also be said of the spruces, cypresses, yews, junipers, arbutus, dogwood, cotoneasters, hollies, and others planted. It is far from advisable to plant trees or shrubs in such unkindly soil without first adding other of better quality; but it is of great value to know that there are a few plants that will thrive almost in defiance of the stubborn and unkindly nature of a stiff clay soil.

Ironstone Soils.—The district to which I mainly refer, and where a few trees seem to be quite at home, is on the coal and ironstone formation, where the top soil is shallow, and the subsoil consists of a loose yellowish rag that is largely impregnated with iron. In most places but a very small quantity of soil exists, and this is of the poorest description, and varying in depth according to the lie of the measure. For all this, several of our largest forest trees seem to do well, but it is principally such kinds as root deeply that succeed in the most satisfactory way, and are able to eke out an existence in such a poor and shingly soil. The Spanish Chestnut is one of the very best trees for this soil, growing with freedom, and producing a fair amount of good timber, while its appearance indicates perfect health. Birch and Beech do well, although neither of them attain to a large size. The latter reproduces itself freely from seed, and soon spreads wherever a footing can be got. Sycamore grows freely, particularly where the pan is broken up, and produces good timber. Another tree that seems perfectly at home on the coal and ironstone is the Wild Cherry, for there it grows to a fair size, flowers freely, and produces excellent timber. Larch cannot be recommended for this soil, but, in places where a small quantity of loam overlies the coal and ironstone, it grows with great freedom for a number of years, and the timber, if cut early, is of good quality. The Spruce soon dies out, although it may, for a number of years after being planted, grow freely enough and wear a healthy appearance. Oak and Ash do fairly well, but they rarely attain to a large size or produce first-class timber. Rhododendrons almost revel in this soil, and some of the largest and healthiest are growing with their roots in close contact with the coal and ironstone.

Concluding Remarks.—In conclusion, it may be pointed out that it is only by a careful selection of soil that we may expect tree-planting to be successful, and I have no hesitation in saying that many failures can be clearly traced to errors in judgment in the selection of trees for planting on particular soils. The subject is a wide and complicated one, and it must be admitted that very perplexing diversities occur with the same kinds of trees on what to all appearance is the same class of soil. There are of course other considerations beyond the soil itself which must be taken into account, such as aspect, elevation, and whether the ground is inland or on the coast.

With reference to some of the newer conifers, it must be admitted that soil and situation have a wonderful influence on their successful culture, and this applies in particular to such kinds as are not perfectly hardy and liable to injury by unseasonable frost. The too common practice of selecting warm and sheltered spots is in the main to be condemned. I have on several occasions removed trees from low-lying sheltered sites to more upland breezy situations, and with marked beneficial results. *Abies Webbiana* and *A. Pindrow* when planted on warm rich soil, at a low elevation, rarely ripen their young wood sufficiently in autumn to withstand severe frost; and as both of these trees are apt in such places to start into growth early in spring, it is the general rule that the young growths are seriously damaged. For these and other trees of a similar nature a northern aspect and fairly rich soil is to be recommended, as in such they do not start growing too early in spring, and are thereby exempt from injury.

In a plantation at 950 feet above sea-level, and planted with many of the newer coniferæ, it is interesting to note the differences in growth between trees of the same genera. *Abies Nordmanniana* and *A. pectinata*, the former hailing from the Crimea, do badly; while *A. nobilis* and *A. lasiocarpa* are thriving apace, and under exactly similar conditions with the former. The soil is a loose gravelly loam resting on rough, shingly gravel; and from this we may infer that *A. nobilis* and *A. lasiocarpa* can subsist on a drier and poorer soil than can *A. Nordmanniana* and *A. pectinata*.

It may be said that *A. cephalonica* and *A. Pinsapo* are not worth growing, and in many places they are not, but when growing on limestone or chalk they are highly ornamental. The same holds good with *A. Albertiana*, *A. Menziesii*, and *A. excelsa*, which are rarely seen in good form except on soil of a peaty description. Everyone interested in trees and shrubs knows that there are certain kinds which in a state of nature are only found growing in a peaty soil, mixed, it may be, more or less, with sand, and any attempt to cultivate them in other soils is productive of very unsatisfactory results. Who would ever think of planting the so-called American or peat plants, Cape Heaths, and the Epacris in, say, leaf soil, gravel, or loam; or Rhododendrons where lime is present in the soil? and these facts show us that there is something in the composition of certain soils only suitable for the roots of a certain class of plants. Another curious fact is this, that when growing on certain soils the timber of one species of tree is found to be far more durable than in others. Deep loamy soil and soft peat produce timber that is usually of a second-rate description, being deficient in firmness.

I have long felt convinced that a great amount of good in pointing out the trees that are best suited for various soils and formations, might be brought about by a careful study of the geological strata. As an illustration, we are here a distance of some seventy miles inland, and at varying altitudes from 300 feet to 700 feet above sea-level. Generally speaking, the soil consists of the different strata of the middle oolite; and to determine which trees thrive best upon it would be a most interesting study, as well as of the greatest value from a forestry point of view. As this stratum runs for a considerable distance and at greatly varying elevations, it would be valuable to learn what difference in the species of trees upon the various districts of it can be noted. The variation in certain trees, say, between the Kentish rag and chalk formation, or between the coral rag and the Oxford clay, lying next to it, is very striking, and well worthy of the attention of planters in these districts. There would be little difficulty in getting together a mass of information in this way, as reports from various districts throughout the country would be of almost universal interest in affording data to planters.

The following alphabetical tables show at a glance the trees which I have found to be well suited for planting in the class of soil under which they are enumerated.

RECLAIMED PEAT BOG.

Hardwoods.

Alnus glutinosa.
,, ,, imperialis.
,, ,, laciniata.
Betula alba.
Cerasus Padus.
,, vulgaris.
Fagus sylvatica.
,, ,, purpurea.
Populus alba.
,, balsamifera.
,, canadensis.
Quercus robur and vars.
Salix fragilis.
Tilia europæa.
Ulmus alata.
,, montana.

Conifers.

Abies excelsa.
,, nigra.
Cedrus Deodara.
Cryptomeria japonica.
Cupressus Goveniana.
,, Lawsoniana.
,, macrocarpa.
Juniperus chinensis.
,, recurva.
,, Sabina.
Larix europæa.
,, Kæmpferi.
Picea nobilis.
Picea Nordmanniana.
Pinus austriaca.
,, excelsa.
,, Laricio.
,, sylvestris.
Retinospora ericoides.
,, plumosa.
,, ,, aurea.
Taxus baccata.
Thuja gigantea.
,, occidentalis.
Thujopsis borealis.
Wellingtonia gigantea.

CHALKY OR CALCAREOUS.

Hardwoods.

Acer colchicum rubrum.
,, dasycarpum.
,, Negundo.
,, platanoides.
,, Pseudo-Platanus.
,, rubrum.
,, striatum.
Æsculus Hippocastanum.
Alnus glutinosa and vars.
Amelanchier Botryapium.
Amygdalus communis.
Betula alba.
Castanea vesca.
Catalpa bignonioides.
Cerasus Padus.
Cratægus (nearly all).

Cytisus Laburnum.
Fagus sylvatica.
,, ,, purpurea.
Fraxinus excelsior.
,, ornus.
Gleditschia sinensis.
,, triacanthos.
Kolreuteria paniculata.
Populus alba.
,, balsamifera.
,, canadensis.
,, candicans.
,, monilifera.
,, tremula.
Pyrus Aria.
Pyrus aucuparia.
,, Malus floribunda.
,, spectabilis.
Quercus Ilex.
,, Mirbeckii.
,, rubra.
,, Turnerii.
Robinia Pseud-Acacia and vars.
Salix alba.
Tilia argentea.
,, europæa.
Ulmus alata.
,, glabra.
,, montana.
Virgilia lutea.

Conifers.

Abies excelsa.
Cedrus atlantica.
,, Deodara.
,, Libani.
Cupressus Lawsoniana.
,, macrocarpa.
Juniperus chinensis.
,, communis.
,, Sabina.
,, ,, tamariscifolia.
Larix europæa.
,, Kæmpferi.
,, leptolepis.
Picea amabilis.
,, magnifica.
,, nobilis.
,, Nordmanniana.
,, Pinsapo.
,, Webbiana.
Pinus austriaca.
,, Cembra.
,, excelsa.
,, Laricio.
,, Pinaster.
,, Strobus.
,, sylvestris.
,, tuberculata.
Retinospora ericoides.
,, filicoides.
,, plumosa.
,, ,, aurea.
Salisburia adiantifolia.
Taxus baccata and vars.
Thuja gigantea.
,, Lobbii.
,, occidentalis.
,, Wareana.
Thujopsis borealis.

GRAVELLY AND SANDY.

Hardwoods.

Ailantus glandulosa.
Alnus cordata.
Betula alba.
Carpinus betulus.
Fagus sylvatica.
Fagus sylvatica purpurea.
Fraxinus ornus.
Gleditschia horrida.
Ilex, many vars.
Juglans cinerea.

Juglans nigra.
Magnolia acuminata.
Morus nigra.
Platanus occidentalis
Populus Bolleana.
Quercus robur and vars.
,, suber.
Robinia Pseud-Acacia.
Sambucus nigra.
Tilia cordata.
Ulmus alata.
,, campestris.
,, montana.
Virgilia lutea.

Conifers.

Juniperus communis.
,, Sabina.
Pinus austriaca.
,, halepensis.
,, Laricio.
Pinus Pinaster.
,, pumilio.
,, sylvestris.
Taxus baccata.
Thuja gigantea.

CLAY.

Carpinus betulus.
Castanea vesca.
Cryptomeria elegans.
,, japonica.
Gleditschia triacanthos.
Quercus Ilex.
,, pannonica.
,, robur.
Thuja gigantea.
,, Lobbii.

IRONSTONE AND COAL.

Acer Pseudo-Platanus.
Betula alba.
Castanea vesca.
Cerasus Padus.
Cupressus Lawsoniana.
Fraxinus excelsior.
Juniperus communis.
Larix europæa.
,, ,, pendula.
Pinus cembra.
,, montana.
Quercus robur.
Thuja gigantea.
Ulmus montana.

XVIII. *The Formation of Plantations.* By JOHN FOWLER ANNAND, Assistant Forester, Brucklay Castle, Aberdeenshire.

1. INTRODUCTORY REMARKS.

In earlier times, when there was a plethora of forest supplies, felling was carried on without any regard to the maintenance of the forest, regeneration being left entirely to nature. But by and by nature ceased to fill up the gaps caused by man's indiscretion, and artificial means had therefore, of necessity, to be resorted to.

In this country, at the present time, restocking the ground by planting is almost the only system practised. It is not from any peculiarity of soil or climate that reproduction by self-sowing is impracticable. That this is so seems evident from the fact that, wherever a plantation is formed in a situation favourable to its healthy development, when the trees are of seed-bearing age, such a quantity of seedlings spring up, whenever an opening presents itself, as would prove all-sufficient for a future crop, if only the necessary protection were afforded for their preservation and future growth. But with a superabundance of ground game, such protection, on an extensive scale, at all events, is practically impossible.

On an estate in West Aberdeenshire, with which the writer is acquainted, a considerable tract of land was entirely cleared of a heavy crop of larch, Scots pine, and spruce. The work extended over a number of years, and during that time, although nothing was done to encourage them, seedlings of the kinds mentioned, along with birch, sprang up all over the ground, and would have required little artificial assistance to have restocked the plantation; had not the bulk of them been destroyed by hares, rabbits, and sheep. And although much of this land is again covered with thriving plantations, yet a considerable saving could have been effected had circumstances been more favourable to the growth of the self-sown trees.

I may mention another instance which came under my notice more recently. Part of a small mixed hardwood and spruce plantation was cut down and immediately replanted. But rabbits were numerous, and the result was, that almost the whole of the plants were destroyed by them. After this, the ground was enclosed with wire-netting and effectually fenced against game, whereupon a close crop of sycamore, birch, willow, alder, ash, etc.—the offspring of surrounding trees—came up in such abundance as rendered artificial aid unnecessary. I do not think the examples I have taken are exceptional. All the broad-leaved timber trees usually cultivated in Scotland, with the exception of oak, which only ripens its seed (in Aberdeenshire, at least) in very favourable seasons, produce abundance of seeds, which germinate readily when conveyed by natural agencies to a suitable seed-bed; and the same can be said of Scots pine and larch.

It is generally admitted that for woods which are to be permanently maintained for economic purposes, a well-organised system of natural regeneration is most desirable, affording as it does a more compact condition in the earliest stages of growth, and hence, as a consequence, a straight clean stem, free from large lateral branches, which conditions are, to some extent, wanting in the artificially formed wood. But it is evident from what has been already noted, and for other reasons which need not here be entered upon, that such a system, however desirable, cannot in its entirety be practised in this country; and it is clear that we must largely depend on artificial planting for the renewal of our woods. Every advantage should, however, be taken of natural growth, when such can be preserved. Planting or sowing must, of course, be resorted to when dealing with land previously unoccupied with a crop of trees, and in the introduction of exotics.

The primary object kept in view in the formation of plantations is that of profit. It has been repeatedly proved, from reliable statistics, that substantial returns can be obtained from plantations, after deducting every item of expenditure connected with their formation and management.

Our foreign trade in timber may soon be attended with difficulties. Our principal sources of supply at present are Canada, and the northern part of the Continent of Europe. The United States can now do little more than supply their own wants. Owing to forest fires, and the generally wasteful system of forestry carried on in Canada, our supplies from that quarter are likely to be very much reduced in the near future. Although the forests of America are still of vast extent, the parts of them available are probably confined within comparatively narrow limits. It is only when the timber is situated in the neighbourhood of navigable rivers that it will pay to cut it for exportation, and as these are just the most suitable places for settlers to occupy, so are they cleared out to make room for corn-growing as the population increases. At the same time, as a natural consequence, more and more timber is required for structural and other purposes within the country. The supplies of the larger-sized timber from the north of Europe are also considerably reduced. It is highly probable, therefore, that in the course of the next fifty years our supplies of timber from abroad will be very greatly curtailed.

We cannot grow all the timber we require at home, but a very considerable proportion can well be produced. Large tracts of land at present worth only a few shillings per acre for grazing purposes, but which are capable of producing Scots pine and larch of the finest quality, are available for plantation purposes.

Mr D. F. Mackenzie, in his address delivered at the thirty-seventh annual meeting of the Royal Scottish Arboricultural Society, put the area thus available, in Scotland alone, at no less a figure than eight million acres; the planting and management of which he considers would give employment to forty thousand persons. Of late the home timber trade, in common with other industries, has been very much depressed, and proprietors have found considerable difficulty in getting a market for certain classes of forest produce. But, with a general revival of trade, prices are certain to improve. Even at present prices, land now lying comparatively waste can be made to yield, if properly planted and managed, an annual rental of from 15s. to 30s. per acre.

2. Laying out the Plantation.

In laying off the boundary line of a plantation, the prevailing winds of the district should be carefully studied, and precautionary measures taken to counteract their destructive effects. In these latitudes, the most violent and frequent winds blow from a westerly direction. On the eastern coast of Britain, however, the most damage is done by northerly and easterly winds. The greatest breadth of the plantation should, if possible, be laid off in the face of the prevailing winds, and on the highest parts to be planted.

As regards the actual form a plantation should take, the individual tastes of the owner, and other attendant circumstances, have to be considered. The best form that can be adopted on the exposed side is the *convex*, the tendency of which seems to be to divide and weaken the force of the storm. Straight lines are, if possible, to be avoided; for, besides presenting an unnatural appearance in the landscape, they are less able to resist outward pressure. As a matter of convenience, however, they have often to be adopted when the plantation is formed in immediate proximity to agricultural land. Apart from æsthetic considerations, it is immaterial what form the plantation should take on the side sheltered from the prevailing winds. The chief aim should be to give its general contour as natural an appearance as possible, in conjunction with the securing of strength to resist storms, the curves of the outline being adapted to the configuration of the ground—the convex form prevailing in rising ground, and gradually giving place to the concave, as it again recedes. I cannot agree with those who attach little or no importance to scenic effect when laying out a plantation. Much can be done to secure beauty of scenery by a suitable arrangement of even the commonest of our forest trees. Each kind possesses shades and beauties peculiarly its own. To use the words of the poet Cowper,

> "No tree in all the grove but has its charms,
> Though each its peculiar hue; paler some,
> And of a warmish grey; the willow such,
> And poplar, that with silver lines his leaf,
> And ash, far stretching his umbrageous arm:
> Of deeper green the elm, and deeper still,
> Lord of the woods, the long-surviving oak,
> Some glossy-leav'd, and shining in the sun,
> The maple, and the beech of oily nuts
> Prolific, and the lime at dewy eve
> Diffusing odours; not unnoted pass
> The sycamore, capricious in attire,
> Now green, now tawny, and ere autumn yet
> Have changed the woods, in scarlet honours bright."

A great deal can be accomplished by judicious grouping. Although it is often necessary in profitable wood culture to have a mixture of different kinds of trees in young plantations for the sake of providing suitable nurses, or for the production of timber likely to prove remunerative when removed as thinnings, there is no reason why this order should be maintained with the permanent crop. Viewed as a whole, and as a prominent object in the landscape, a plantation will produce the best effect at every season of the year when the trees are grouped or massed together according to their several varieties and shades of foliage.

3. Fencing.

It is absolutely necessary, before commencing to plant any piece of ground, to have it thoroughly fenced against sheep and cattle. Many different methods of fencing are in use at the present time, each one possessing peculiar advantages, according to the circumstances in which it may happen to be required.

Where shelter is of importance, nothing answers so well as *thorn hedges* or *stone dykes*. In good land the thorn hedge makes a very permanent and ornamental fence. If, however, the soil is of a light character, or the situation very exposed, it will be necessary to introduce a mixture of beech, one beech to two thorns being the best proportion. The beech thrives in a much lighter soil than the thorn, and also retains its leaves during the winter. In this way, by the shelter and nursing afforded by the beech, the thorn can be successfully cultivated where otherwise it would not grow freely. The bed for the hedgerow should be thoroughly trenched, at least 18 inches deep, and all weeds and large stones carefully removed. If the subsoil be of a stiff or retentive nature, it should be thoroughly loosened with the pick, but in general it is not advisable to bring much of it to the surface, unless the ground is of a peaty nature, in which case it will supply the necessary mineral matter so deficient in such soils. The quality of the soil should be equalised as much as possible, that of an inferior nature being removed, and richer put in its place. In this way a more equal growth is at once secured and maintained. A temporary fence must be erected to protect the hedge until it is able to act as a fence itself. It should be neatly trimmed at least once a year, and all encroaching branches from the neighbouring trees kept in check.

Stone dykes are probably the best fences in use for enclosing plantations, and if stones are plentiful within a reasonable distance, are ultimately the cheapest. They possess the great advantage over hedges of at once affording considerable shelter to the young trees.

The dry-stone dyke (as the term implies) is built without mortar, with the exception of the cope or top stones, which should be all well bedded and pointed with lime. By attending to this matter, the fence is much less apt to be broken down. Dykes are built of various heights, but 4 feet, including cope, is usually sufficient for enclosing plantations. To make the fence thoroughly efficient and proof against Highland sheep, two wires fastened to small iron standards should be placed on the top. The standards should be set 9 feet apart, and firmly "batted" into the stones with lead or cement; pillars for straining the wires being placed in the dyke 150 yards apart.

Turf dykes were formerly much in use for enclosing plantations. In many high-lying districts of the country, where stones are not easily procurable, and where, from the nature of the soil and situation, hedges are not likely to succeed, they are still not infrequently used. They form at best a very insufficient fence, and in order to make them proof against sheep and cattle, they must be surmounted by a wire fence. But when we consider that wooden posts so situated will not probably last half so long as when fixed in the natural ground, and that only a very little saving in wood and wire can be effected at the outset, it is questionable if very much advantage is to be gained by the erection of turf dykes at all, except, of course, as shelter for the young plants.

The form of *wire fencing* most generally in use for enclosing woods in Scotland is that with wooden posts and strainers. The straining posts should be made of thoroughly seasoned larch of mature growth. They should be 7 feet long, 6 inches square, or, if round, 7 inches in diameter. The intermediate posts should also be made of larch, $5\frac{1}{2}$ feet long by $3\frac{1}{2}$ inches by 3 inches, or, if round, $3\frac{1}{2}$ inches in diameter at the smallest end. The strainers should be pitted into the ground 150 yards apart, with an additional one at every sharp curve that occurs in the line of fence. Brackets for straining the wires should also be attached to the strainers. The brackets possess the great advantage of permitting the wires to be slackened or tightened at pleasure. This is a matter of great importance when any accident befalls the fence, or when temporary openings are required. The intermediate posts should be pointed and driven into the ground 6 feet apart. In order to make a substantial fence against cattle or sheep, it should be provided with six No. 7 wires, and should measure, when completed, 3 feet 6 inches high. The distance between the two upper wires should be 10 inches, and the remaining spaces respectively 8, 7, 6, 5, and 6 inches between the lower wire and the ground. The tops of the posts should be rounded off to prevent the lodgment of water. This fence can be erected at a cost of $5\frac{1}{2}$d. per yard.

4. Drainage.

An elaborate system of drainage, such as is required for the growth of agricultural crops, is neither necessary nor practicable when dealing with land to be occupied with a crop of trees. For, when once established, the trees perform for themselves, in a great measure, the necessary drainage. No sooner do they rise to a height sufficient to be affected by the wind, than by their own movements the soil is loosened around the roots and the superfluous moisture readily sinks to a depth at which in most subsoils it cannot injuriously affect the health of the trees. By the gradual enlargement of the roots also, the soil is more and more broken up, and its porosity increased. In planting for ornament alone, the ground is generally trenched and drained at a cost equal to what is necessary in agricultural practice, but in this case the soil may be quite unsuited to the varieties of trees to be planted, without such preparation. But, of course, objects other than profit are kept in view in such instances. By a proper distribution of the various kinds of trees over soils suitable for their respective requirements, the expense of draining may be reduced to a minimum. Trees which thrive in soils of a dry nature should not of course be planted on those of a directly opposite character, and *vice versa.*

In general, all that is required is to form surface drains to carry off stagnant water. It is very seldom that all the land in large enclosures requires draining, but where necessary this should on no account be neglected, as no preparation of the soil is of so much importance to the health of the trees in the earliest stages of their growth. The nature of the soil will determine the dimensions of the drains, and the distances at which they should be placed apart. If the soil is of a stiff clayey nature, they will require to be deeper and closer than in other cases. In general it will be sufficient to have the drains cut at from 30 to 40 feet apart. The main drains should always be made on the lowest part of the ground, and where the easiest natural outfall can be obtained. They are usually made 24 inches deep, 30 inches wide at the top, and 10 inches at the bottom, and the subdrains 15 to 18 inches deep. On soils where *moorband pan* is present and in the course of formation, the drains should be made at least one year before the ground is planted, in order that the stagnant water may get time to drain off, and the soil be made pervious to air and rain-water, both of which greatly assist in breaking up the *pan*, and checking its further formation. In preparing peat mosses for the growth of trees, the drains will require to be made much deeper than in ordinary cases, in order to make allowance for the subsidence that usually takes place when the water is removed. Owing to the soft nature of the ground, however, they can be made at a much cheaper rate than they could be in soils of a different character. Where practicable, a little of the substratum on which the peat rested should be brought to the surface and spread equally over the ground, thus providing for the necessary supply of mineral matter usually so deficient in such soils. The cost of making ordinary surface drains will vary from 5s. to 8s. per hundred yards, according to the condition of the ground, and the price of labour in the locality.

5. Making of Roads.

It is a matter of paramount importance, before commencing to plant any piece of ground of large extent, to have the principal lines of roads at least marked off, if the work of construction is to be delayed till a later date. If this precaution is neglected, and the whole of the ground planted, it will often be a matter of extreme difficulty to fix upon the best route for the road after the trees have attained a height sufficient to obstruct the view; and what may appear to be the best line of road at one point is quite impracticable at another. It is not necessary to have the principal roads laid off in straight lines. In fact, it is very undesirable to have them so constructed, affording, as they do, an unrestricted passage to the wind.

The object aimed at in forming the roads is to provide as easy an access as possible to every part of the plantation. It is not necessary that all the roads should be constructed on an expensive scale, but only those which have to undergo constant tear and wear. For those of minor importance, it will be sufficient to have ditches cut to carry off stagnant water from the surface. The principal roads should be of sufficient breadth to enable two carts or waggons to pass each other without inconvenience.

The great secret of success in the maintenance of roads is to have them as nearly free from moisture as possible. On hilly ground, where the soil is of an open and gravelly nature, metalling can often be dispensed with altogether. If the road is formed along the slope of a hill, sufficient material is usually found on the highest part to make up the deficiency on the lower, and complete the construction of the road; and, if it is kept smooth and dry, it will be found to be as permanent as if it had been metalled at great expense. When it is found necessary to convey material for the construction of the road, a box or longitudinal trench should be cut out for its reception. The metal may either be broken and carted on, or the stones may be carted on whole and broken into the road. It is necessary to have a bottom layer of 5 inches, and an upper one of 3 inches, the size of the stones not exceeding 3 inches in the former, nor $2\frac{1}{2}$ inches in the latter. The road should be thoroughly pressed together with a heavy roller. A "blinding" of sharp gravel may then be spread on the surface, and the rolling repeated. "Trail" roads should also be provided for conveying the produce to the principal thoroughfares. As they are much narrower than the cart roads, they may be made in straight lines. They can be so laid out as to divide the plantation into convenient working blocks. They are also handy for sportsmen.

6. Preparation of the Ground.

In Scotland, waste land is generally covered with heather, whins, or broom.

The best and cheapest method of clearing land of a heavy crop of heather is to burn it. This is a very dangerous operation when conducted in the immediate vicinity of plantations. Much damage is often done by the fires being allowed to enter the woods. This evil can easily be guarded against by having men in attendance with brooms or other suitable appliances to keep the fire within due limits. If the situation is very much exposed, strips should be left at intervals to shelter the young trees. This work is best accomplished in autumn or early in spring. It should be done at least three years before the ground is planted.

This interval is necessary in order that the surface may again be covered with vegetation. Young trees seldom do well when planted while the ground is entirely bare from the effects of burning. The reason of this is that the soil is in too loose a condition, and admits drought and frost too readily. If the heather does not exceed 6 inches in length, it is quite unnecessary to burn it, as it offers no impediment to the planting of the smallest trees in use. Whins and broom are more difficult to get rid of. They can of course be burned, but this seems rather to foster than check their growth. Not only do the old plants spring anew from the roots, but, owing to the condition of the ground after the burning takes place, seeds lying dormant are enabled to germinate; and both crops coming up together, the ground is in a worse state than ever. No doubt the most effectual way of getting rid of them is to grub them up entirely by the roots, but this is a very expensive operation, and often necessitates an expenditure of as much as £4 per acre. A cheaper method may be adopted. When the ground is entirely covered with whins or broom, strips about 2 feet wide, and from 3 to 4 feet apart, are cut through them, and the plants put in along these. By a little attention for the first few years the whins and broom will easily be prevented from unduly interfering with the growth of the plants. Where tall grass occurs it is necessary, if the plants are to be notched into the ground, to pare off patches of the surface about 15 inches square, on the spots where the plants are to be inserted. This will enable the plants to get a good start before the grass can again grow with its usual luxuriance.

Trenching is an expensive operation, and is seldom resorted to as a preparation for young trees. When planting is done with a view to profit, it is better to leave the land in its natural condition, not only on the ground of economy, but that the timber may not deteriorate in quality, which, in the case of conifers at all events, it certainly will do, if growth is unduly accelerated by artificial means. In forming shelter plantations, however, on the sea-coast trenching may with advantage be resorted to; and it very often happens that trees are made to grow by thus preparing the soil, when attempts to follow the ordinary method of planting result in failure.

7. Soil and Climate.

When it is considered that a period of fifty, sixty, or one hundred years must elapse before the full value of a crop of trees can be realised, it is obvious that great forethought and careful discrimination must be exercised by the planter. Errors committed at the outset cannot, as a rule, be remedied during the whole life of the trees composing the plantation. One of the most serious of such errors is committed when planting operations are carried on without sufficient care being taken to select each variety of tree for the *soil* for which it is naturally fitted. Nothing is more common than to find trees, which nature has adapted for a light dry soil, planted on the stiffest and most tenacious of clays, while those that would flourish, and attain to large dimensions, on stiff ground are planted on the lightest of gravelly or sandy soils. What wonder then if, in such cases, planting should result in comparative failure? The nature of the soil, therefore, is the most important consideration when the formation of a plantation is contemplated.

Another consideration of scarcely less importance is that of the *climate*, which may be influenced by the nature of the soil, configuration of the district, altitude, proximity to the ocean, exposure, aspect, etc. The effect of elevation on the growth of trees is very noticeable. It is well known that as we ascend in height the temperature gradually and regularly decreases, and trees thriving at the foot of a mountain will not be found at the top. Even in a country possessing so little variation in height as our own, this effect is well seen. Abundant proof of this natural distribution of trees is to be seen in the forest remains found embedded in existing peat mosses. The low fertile ground is seen to have been covered with oaks, while the pine, birch, and willow had occupied the high elevations. It is only by an approximation to this natural distribution that we can hope to attain to great success. The greatest height at which the Scots fir is said to grow is 2000 feet above sea-level, but it cannot be expected to grow to timber size at such an elevation. Probably 700 feet is the utmost limit at which timber can be profitably grown within 12 miles of the sea-coast. Trees are said to thrive at a higher elevation in Perthshire than anywhere else in Scotland. This is no doubt owing to the distribution of the mountain ranges, and the perfect immunity from sea blasts enjoyed by that county. Taking the county of Aberdeen as an example, it may be noticed that more difficulty is likely to be experienced in forming plantations at an elevation of 400 feet in the Buchan district of the county, than would be the case at twice that elevation in the western part along the hill-sides of the Dee and Don. The reason is obvious. Buchan is fully exposed, both on the north and east, to the sea blast, the damaging effect of which is noticeable at least 12 miles inland. Owing to its situation, the western part of the county is not affected by the sea, the hill ranges being so situated as to break the force of the storm, and rob the wind of much of the saline matter so fatal to certain classes of trees. Hence timber can be grown at a much greater elevation in this part of the county.

Aspect and exposure exercise a modifying influence also on tree growth. One would, on first thought, naturally conclude that, for trees of a delicate nature, or for those that are liable to be injured by spring or autumn frosts, a southern exposure would be most congenial. This is not, however, in accordance with facts, and it is allowed that, if soil and elevation be favourable, a northern exposure answers equally as well as, if not better than, a southern. Although in the former case the full benefit of the sun's rays is not always obtained, yet it has compensating advantages not possessed by the latter. It is less influenced by the violence of south and east winds, which frequently prevail, and are so very destructive to vegetation during the growing season. The north winds most frequently occur during the period of rest, and seldom prove so injurious. Hence we find that even the broad-leaved timber trees, which require a higher degree of heat than conifers to bring them to maturity, grow as freely, and attain to as great height, in a northerly as in a southerly exposure.

Our British climate is proverbially variable and uncertain. This is more noticeable in the spring months than at any other time during the year. From March to June it is no uncommon experience to have intense heat, mild showers, frost, hail, snow, cold and destructive winds, all following each other in rapid succession, and very often within the space of twenty-four hours. These may be said to constitute our usual spring weather. Our native plants are by constitution adapted to these changes, but the successful cultivation of exotics, accustomed to a more equable climate, is often a precarious undertaking. In selecting trees of foreign origin for plantation purposes, preference should be given to those which most readily adapt themselves to the variableness of our climate, and they should if possible be placed in exposures, such as north and west, where they are least likely to be damaged in the early part of the growing season.

With these remarks on soil and climate, we now proceed to consider more in detail the soils and situations best adapted for some of the more commonly cultivated of our forest trees.

8. Common Forest Trees.

The Oak (*Quercus Robur*). The soil most suitable for the oak is a strong clay loam resting on a clay subsoil. But though a soil of this description is required to bring it to its greatest dimensions, we often find it growing to considerable perfection on land of a sandy or gravelly nature. Being of slow growth, and of little value when young, it need not be planted closer than 12 feet apart, with nurses between of a suitable kind. In order to produce tall, well-grown trees, it is an indispensable condition that the plants be provided with shelter, either natural or artificial.

The Ash (*Fraxinus excelsior*). This tree requires a soil of a moist nature to bring it to perfection. It grows well on any good loamy soil, if the subsoil is of a moist nature. Excellant quality of ash is also to be found growing on soils of a peaty nature, if the subsoil is clay. It does not succeed at high elevations, and it is vain to attempt to grow it on poor, thin land, such as is likely to suffer from drought in summer. But if planted in a favourable situation it will be found to give quicker, and perhaps larger, returns than any other deciduous tree.

The Wych Elm (*Ulmus montana*). Poor shallow land is as inimical to the growth of the elm as the ash. Its favourite soil seems to be of a rich clayey nature, with a moist subsoil. If provided with a sufficient depth of earth, and within the reach of water, it will succeed well on a great variety of soils. The best specimens are almost invariably to be found on the banks of a running stream, where they are provided with sufficient moisture without having stagnant water about the roots. If grown by itself, the elm may be planted at 12 feet apart, but it is more commonly mixed with other timber trees. It requires shelter to bring it to useful size.

Sycamore (*Acer pseudo-platanus*). Perhaps no tree is more accommodating as to soil and situation than the sycamore. The soil on which it attains to its largest size is a light loam resting on gravel, but it thrives almost equally well on soils of a tenacious quality, if these are not surcharged with moisture; and it will also attain to a fair size on peaty soils. It is most valuable for planting on exposed situations, and for forming shelter to timber trees of a more delicate character. Not only does it thrive at high elevations and on severe exposures inland, but it is perhaps the best tree that can be planted for shelter where the influence of the sea-breeze is much felt. Its timber is most valuable when of large dimensions.

Beech (*Fagus sylvatica*). Soils of a light sandy nature are best suited to the growth of the beech. It will also grow to fair size on rather stiff clay, if thorough drainage is effected. It is not suitable for planting on wet or mossy soils. It grows at a high elevation inland, but does not stand the sea-breeze so well as the sycamore.

The Horse-Chestnut (*Æsculus Hippocastanum*) and the Lime (*Tilia europæa*) thrive on a great variety of soils of a dry loamy nature, but will not succeed in very exposed situations. They are more useful as ornamental trees than for producing timber.

Birch (*Betula alba*). The birch delights in mountainous regions, and is to be found growing naturally almost everywhere in the Highlands of Scotland. It succeeds at a great elevation, and in a variety of soils. It seems to grow equally well on loamy, sandy, gravelly, or peaty soils, and will thrive in loftier situations than the native pine or any other of our cultivated trees.

The Alder (*Alnus*), the Willow (*Salix*), and the Poplar (*Populus*) are not of first-rate importance as timber trees, but they thrive in a great variety of poor soils of a damp character, and form valuable shelter belts in such situations.

Scots Pine (*Pinus sylvestris*). Among conifers, the Scots pine claims first attention. It is the only pine indigenous to Britain, and is one of the hardiest timber trees in cultivation. It is highly probable that in early times the greater part of Scotland was covered with forests of this tree, and in any scheme of re-afforesting in the Highlands, it will be more largely used than any other. It thrives in very poor soils, and at high elevations. Dryness is the most indispensable condition land can possess in order to produce a full crop of Scots pine. The most suitable soil is perhaps a sandy or gravelly loam on a rocky subsoil, but it will grow on any well-drained soil, with the single exception perhaps of chalk. It is impatient of the sea-breeze, and if planted where this is much felt, shelter belts of deciduous trees should always be provided. In mountainous regions inland, it will produce valuable timber at a higher elevation than any other timber tree, except the birch.

Larch (*Larix europæa*). Although good specimens of this tree are often found in clay soils in flat districts, it is along the hill-sides, on open rocky soils, where a free supply of moisture is obtained, in combination with a thorough natural drainage, that it grows to the greatest perfection. It affects cool, moderately elevated situations, with a clear, dry atmosphere. Perhaps no better example of the successful cultivation of this tree is to be found than on the hill-slopes along the valleys of the Dee and the Don, in Aberdeenshire. Magnificent specimens are to be seen at Paradise, on the Monymusk property, at an elevation of about 350 feet above sea-level. But apart from individual specimens, extensive thriving plantations of the larch have been formed on most of the wooded properties in the western part of the county. But in these situations it is by no means free from disease, and, where due regard has not been had to the proper selection of sites, the results have been anything but satisfactory. I cannot agree with those who declare that it will thrive at higher altitudes than the native pine. It certainly will *live*, but it cannot be profitably cultivated.

The larch is much subject to disease, the great predisposing cause of which can apparently be traced to the variableness of our spring weather. No degree of cold ever experienced in this country can injure the tree in winter, but few are so sensitive when in foliage. The fine weather often experienced in early spring brings the larch into leaf, only to be checked, perhaps ruined, by cold east or south-east winds, or late frosts. To prevent this as much as possible, it should be planted on north or north-west exposures, and preference should be given to home seed, the produce of foreign growth being less suited to the changeable nature of our climate.

The Spruce (*Abies excelsa*). The spruce requires shelter to bring it to useful timber size, and is more suitable for valleys than mountain sides. Although it endures any degree of cold during winter, it seldom grows to large size in exposed situations, and it is one of the worst trees for planting within the influence of the sea. The spruce is very shallow rooted, and is best adapted for soils of a cool moist character; and it is one of the few trees that will succeed where the subsoil is of a wet, retentive nature. It also grows well on peaty soils, if provided with shelter belts of deciduous trees, such as the birch or sycamore.

Silver Fir (*Picea pectinata*). The silver fir attains to greatest perfection on loamy soils of a moist nature, but it will thrive on most soils that are not liable to be affected by severe drought. It does not grow at so high an altitude as the native pine, being found in its native habitat in association with the oak. It is very liable to be damaged by spring frosts, and it should be protected from this by being grown in the shade of other trees in the early stages of its existence. It thrives with an amount of shade that would entirely destroy other trees. For this reason it is very valuable for growing under the shade of old trees which are to be removed at a later date. When it is once established, and has reached the height of 15 or 20 feet, it assumes a more robust habit of growth, and the buds on the top shoots being later in coming into leaf, it is much less liable to be damaged by late frosts.

The Newer Coniferæ.—A great variety of these exotics is now cultivated in this country, but chiefly for ornamenting lawns and pleasure grounds. A few bid fair to prove valuable as timber. Among these may be noted *Abies Douglasii, Abies Menziesii, Picea nobilis, Picea Nordmanniana, Pinus Laricio, Wellingtonia gigantea, Cupressus Lawsoniana, Thuia gigantea.*

The various species of *Picea, Pinus, Cupressus, Wellingtonia,* and *Thuia* seem to thrive best on light dry soils, while those of *Abies* prefer moist or peaty soils. Perhaps as regards quality of timber the first place must be given to the Douglas fir, and if accorded the proper sylvicultural treatment, it may yet prove a formidable rival to the larch, the timber of both very much resembling each other. The Douglas fir will not succeed on exposed situations, nor within the influence of the sea-breeze, but the same remarks may, with equal propriety, be applied to the common spruce fir. One thing is evident, the Douglas fir will flourish where the larch almost refuses to grow at all. In a soil and climate far too moist for the larch, it will form valuable timber if provided with sufficient shelter. It should be observed, however, that until we are better acquainted with the timber-producing qualities of the pines and firs of recent introduction, they should be used experimentally rather than generally. It certainly would be an egregious mistake, and one that would likely lead to great disappointment and loss, to use them promiscuously until we have acquired some such knowledge.

9. General Remarks.

When planting is done with a view to profit, the more valuable of the broad-leaved timber trees should not be used in situations where their growth is known to be slow, for not only is there a loss in quantity of timber in such cases, but the quality also is of an inferior description. Some of the hardier of them may very properly be used in forming shelter belts for the more surface-rooted coniferous trees; for though they will not form valuable timber, they afford sufficient shelter to permit of plantations of conifers being formed, with much better prospects of success. Trees can be grown at a much greater elevation inland than near the coast. Deciduous trees withstand the sea-breeze better than pines and firs. The sycamore is the hardiest of all in such situations, the beech, willow, ash, and poplar following in succession.

Coniferous trees form valuable timber in much poorer soils than hardwoods. In fact, the quality of the wood is generally inversely as the quantity, and is accordingly impaired when the trees are planted where their growth is very rapid. As has been already remarked, a north or north-west exposure is to be preferred for the growth of exotics, as they are less excitable in the early part of the growing season in such situations, and hence are less liable to injury from late frost, cold south-east winds, etc. As regards the propriety of having woods in a mixed or in a pure condition, much might perhaps be said in justification of either method; but, *ceteris paribus*, if the soil is suitable for different varieties of trees, it is always safer to use different varieties than to depend on one, although this mixed condition need not necessarily be maintained throughout the whole life of the trees composing the plantation.

10. Selection of Plants.

Much of the future success of a plantation depends on a careful selection of plants. It is only when the planting of large enclosures is contemplated that it will pay to form nurseries in their vicinity for the purpose of raising the necessary plants; although it must be admitted that trees so raised are hardier, and have a better chance of at once establishing themselves when permanently planted out. Some condemn the system of procuring plants from public nurseries suitable for immediate planting, and recommend as an improvement the purchase of seedlings therefrom, and the growing of them in a home nursery till they attain to size suitable for planting in the woods. Now, as the home nursery, as a matter of convenience, is often located in the most sheltered part of the estate, it is very questionable if any advantage can be secured by such a course of procedure. If, however, it occupy a well-exposed site, or is situated in the vicinity of the land to be planted, the practice has much to recommend it.

From the extensive nature of the operations in a public nursery, the professional nurseryman can always command at the cheapest rate the amount of skilled labour and attention so necessary for the successful rearing of seedlings. These he can therefore supply at a cheaper rate than they can be produced in a home nursery, where the same amount of attention cannot so readily be given them. But when the plants are removed from the seed-bed, and transplanted into lines, they necessarily occupy a large space of ground, and a proportionately heavy rent charge must be laid on them; and when it is considered that land occupied as public nurseries is generally near some large city, and is worth perhaps ten times more than the home nursery ground, it is easily understood why large transplanted trees from the public nurseries must be dearer than those grown at home.

It is our own opinion, therefore, that when the planting operations are not so extensive as to warrant the establishing of nurseries on the site of the projected plantations, the most economical method is to procure seedlings from the public nurseries, and rear them in a well-exposed home nursery to a size suitable for the enclosure to be planted. When purchasing plants, it must be observed that a due proportion should always exist between roots, stem, and branches; and preference should not always be given to those which *apparently* are the most vigorous and free-growing, for very often these are sparsely rooted, and will not readily establish themselves when transplanted. It is an indispensable condition that the plants be possessed of one unblemished leading shoot, and *only* one. Conifers may be considered useless when their leaders are damaged. It is quite a simple matter to introduce any disease or insect pest into a plantation, but it will usually be found to be an impossibility to eradicate either when once established. Those plants exhibiting the slightest symptoms of disease or insect attack should therefore, in every case, be rejected. It is of paramount importance, then, to select healthy, well-proportioned plants, entirely free from defects of even apparently the slightest importance.

11. Size of Plants, and Distances at which each Variety should be Planted apart.

On high, exposed sites, where rank herbage has not to be contended with, small plants should always be used. It is a very common mistake to use too large plants for such places. Their age should not exceed two years. Two-year seedlings, or one-year seedlings one year transplanted, are much more likely to prove successful than if large transplanted trees were used, their roots having ample time to establish themselves before they grow to a size sufficient to be affected by the wind. These remarks apply to conifers only, it being assumed that the more valuable of the broad-leaved trees will not be planted in such places. In sheltered situations, where tall grass and similar hindrances to plant growth have to be guarded against, plants of considerable size must be used. Two-year seedlings two years transplanted will often be found small enough. The longer conifers remain in the nursery lines after they reach the age of four years, the less likely are they to succeed when removed to their final destination. The roots of firs become more and more woody as they advance in years, and fewer fibres are developed. As much of the success in transplanting depends on the plentifulness of these fibres on the roots, it will be easily understood how precarious an operation this becomes when the trees are of considerable age. Deciduous trees are much better provided with fibrous roots at every period of their existence, and can thus be removed at a greater age than firs. But economy at the outset, and after success in the growth of the plantation, decide us in using the smallest size of plants compatible with the natural condition of the ground.

In forming plantations of deciduous trees, these are usually planted at wide distances apart, and the intermediate spaces filled up with conifers. If the plantation is a mixed one, the trees are planted at from 9 to 18 feet apart, according to soil, varieties selected, local demand for small-sized timber, etc., the ground being of course filled up with coniferous "nurses." When each variety for the ultimate crop is planted separately, oaks are placed at 9 feet apart, ash at 7 to 8 feet, elm at 12 feet, beech at 6 to 8 feet, sycamore at 9 feet. When plantations are formed purely of conifers, Scots pine and spruce are placed at from 3 to 4 feet, larch and silver fir at from 3½ to 5 feet, and Douglas fir at 8 feet, with cheaper trees as nurses.

12. Season of Planting.

Planting operations of an extensive nature may be successfully carried on in this country at any time from November to April, both inclusive. On dry, hilly ground, autumn planting proves most successful, the plants having time to establish themselves before the drought of the ensuing summer sets in. Planting in the dead of winter is by some objected to, but I have failed to observe any bad effects result from this, and very often the weather is much more favourable at this period than any other time during autumn or spring. When dealing with wet land, where sufficient time has not elapsed after draining to permit of the stagnant water being properly removed from the surface, planting should be deferred till spring. The same plan should be adopted where no natural herbage is present on the ground, as in the case of exhausted peat bogs.

13. Methods of Planting.

Three distinct methods of planting may be enumerated, namely—*pitting*, *double notching* with the spade, and *single notching* with the hand-iron.

The *pitting* system should always be used in the case of deciduous trees, and of large-sized conifers. The pits or holes made for the reception of the trees should always be large enough to contain the roots of the plants when extended at full length. The earth removed from the pit is laid aside, and the surface turf placed in the bottom. This has the double advantage of placing next the roots of the plant a better quality of soil than is generally to be found at any considerable distance from the surface, and also of effecting a considerable check on the growth of weeds till the plant has time to fix itself in the ground, and be in a position to smother all undergrowth. In putting in the trees, two persons are employed. One holds the plant in a vertical position in the centre of the pit, while the other shovels in the earth till all the roots are sufficiently covered. The earth is then subjected to a firm treading with the feet to secure the plant in its proper position, and the operation is completed.

Notching is a much cheaper and more expeditious method of planting, but can only be practised in the case of conifers. For double notching no better implement can be used than the common garden spade. To produce satisfactory results, the spade should be provided with a straight handle. Striking the spade smartly into the ground, the planter forms two cuts as nearly as possible at right angles to each other, thus L. Care should be taken to make the first cut as nearly perpendicular as possible, otherwise it will be impossible to place the plant in proper position. After having made the two cuts, the planter depresses the spade towards himself, and turns it in such a way as to raise the angle of turf formed by the cuts. An assistant then draws in the plant with the roots below the spade. The spade is then withdrawn, and the turf springs back and covers the roots. A smart stroke with the heel to fix the plant completes the operation. In this way a man and a boy will insert from eight hundred to twelve hundred plants a day. This method of planting is suitable for transplanted firs too large for being inserted with the hand-iron, but for which it is unnecessary to provide pits; and it is perhaps more generally in use for planting moorland than any other.

The hand-planting iron is not in general use south of the county of Aberdeen. The implement resembles a common garden spade, but is so small as to be used quite easily with one hand. It measures from 17 to 18 inches in length, and weighs three pounds. The planter holds the iron in his right hand, and strikes it into the ground with a force sufficient to make a cut about 3 inches deep. Then pressing the iron down towards himself, he gives it a slight turn to the right. The plant is then put in at this opening, and the iron withdrawn. The planter then fixes the plant by giving the cut turf a smart stroke with the heel as he steps forward. In this way an experienced workman will insert from two to four thousand plants a day. The plants are carried in a bag slung across the shoulder, and hanging down at the back within easy reach of the left hand. Five hundred seedlings can thus be carried without inconvenience to the planter.

This method of planting is certainly the cheapest in practice, and can often be used when other means are impracticable. It must be clearly understood, however, that it is only suitable for planting seedling conifers, where the heath does not exceed perhaps 8 inches in length. It can never be practised with hardwoods nor large transplanted conifers. If this is attempted, failure only can be the result. But as has been already stated, in bleak exposures and rocky situations, almost unmanageable in any other way, planting with the hand-iron is the cheapest and most efficient system in practice, and the cost will seldom exceed twenty shillings per acre.

Planting operations should never be carried on when the ground is affected with frost in the slightest degree, and many failures in planting, often attributed to other causes, could very likely be traced to this. Dull, moist weather is the most suitable of any, and if such weather is selected for the work, planting operations can successfully be carried on from early autumn to the end of April.

14. Sowing.

This method of forming plantations is subject to many of the objections already noted regarding natural reproduction, and can seldom be taken advantage of in this country. There is one case in which it is infinitely to be preferred to planting, namely, when forming plantations of oak.

As every one knows, the oak is a distinctly tap-rooted tree, and when one or two years old, its roots are very destitute of fibres. It is therefore almost an impossibility to successfully transplant it. A great many will die off at once, and many of those which survive the operation are generally so much injured as to assume a stunted habit of growth, and seldom attain to full size. Instead of being transplanted, the oak should then be raised from the acorn in the spot where it is intended to grow. The ground may be prepared in the same way as for the reception of other hardwood plants, pits being made at 9 feet apart. Two or three acorns should be "dibbled" into each pit, allowance in this way being made for bad germination and other accidents. All the plants but one in each pit should be removed after a year or two. If the ground is suitable for their growth, the intervening spaces may be filled up with larch plants. If it is too stiff for the larch, Scots pine or spruce is to be preferred. In either case, two-year seedlings two years transplanted should be used in order to provide sufficient shelter for the oak seedlings by the time they appear above ground.

There seems little reason to doubt that the finest quality of all kinds of timber is to be obtained in the plantation formed directly by seeding, and we have only to look to the natural pine and birch forests in the north of Scotland, or to those of the oak in England, for illustrations of this fact. It is much to be regretted that the practice cannot more generally be adopted.

15. Management for the First Twelve Years.

"What is worth doing, is worth doing well." It very frequently happens, when there is a fair appearance of a crop of trees on the ground, that the making up of failures is entirely neglected. Now this is a great mistake when the rearing of a full crop of clean-grown timber is aimed at. The more space trees are allowed for the growth of side branches, the coarser and knottier will be the timber. It is of the utmost importance, therefore, that every blank should be filled, and the ground completely stocked. Grass, whins, briers, and other rubbish should be kept down when they are likely to overtop or damage the plants in any way. When once properly established in the ground, and growing freely, the trees are able to take care of themselves, and ultimately smother out undergrowth of every sort.

Pruning.—This will commence the first year after planting. All the plants should be carefully examined, and wherever one is found to have become sickly, from any cause, it should be cut over at the surface of the ground. This will cause it to send up a few shoots from the root. These shoots are all cut away the following summer, except the strongest one, which is retained as the future tree. Moderate annual prunings are better than severe prunings at long intervals. What is aimed at is to restrict the plant to one leading shoot, and to prevent the laterals from developing too much at the expense of the stem. If a proper stocking of trees is maintained on the ground, this is all the pruning that is required. It is an expensive operation, and requires a greater amount of skilled labour than is generally obtainable. Although it cannot altogether be dispensed with in the case of hardwoods, the less pruning trees require the better. No doubt trees are benefited by having limbs and large branches removed, as much of the nutriment that would go to feed these is utilised by the stem, and evaporation by the leaves is restricted, but the blemishes caused in the timber by the operation of pruning more than counterbalance any such benefit. By maintaining a proper distribution of the trees on the ground, the necessity for pruning will be greatly lessened.

Thinning.—We frequently hear the advice given, "thin when the branches begin to touch." This is wrong. Take, as an example, the Scots pine. By thinning to the extent indicated, the branches are allowed to spread and enlarge to a considerable size. These branches will, in the course of time, die and drop off, but before this takes place, large black knots will be enclosed in the stem, and the quality of the timber will suffer in consequence. Light is also too freely admitted to the lower part of the stems in the early part of the growing season, and consequently an undue proportion of "spring," or porous, wood is present in the annual wood increment. When Scots pine was used almost entirely for railway sleepers and similar purposes, large sizes rather than fine quality was a desideratum, and it was perfectly justifiable to submit the woods to severe thinnings in order to attain this object. Now all this is likely to be changed, and timber of all kinds, but especially Scots pine, must be of good quality, and as free from knots as possible, before it can meet the requirements of the market, or directly compete with the foreign product. We cannot afford to overlook the fact that by far the greatest amount of timber imported from abroad has been produced in the natural forest, and the quality of this timber is such that it occupies the first place in the market, and in many cases to the entire exclusion of the home article.

We cannot entirely copy nature when dealing with artificially formed plantations, but many important lessons are nevertheless to be learned. In the natural forest, trees are present of every age, from the seedling to the centenarian. Now, while those of older growth have ample opportunity of developing in an upward direction, the smaller but equally vigorous plants growing up all around, entirely prevent the growth of laterals in the lower part of their stems, and at the same time the necessary shading, so indispensable to the production of fine quality in timber, is provided for, and this process goes on *ad infinitum.*

In the artificial plantation, on the other hand, the trees are all of the same age, and nearly of the same height, and the destruction of the whole plantation would result from entirely neglecting to thin, as in the natural forest. But the artificial plantation must always possess one great condition in common with the natural forest, namely, a sufficient closeness in the order of the trees, to provide for the shading of the lower parts of the stems, and the production of clean-grown timber.

By preserving the plantation in such a condition, the following advantages may be secured :—*first,* grass and weeds of every sort are entirely kept in check; *second,* the fertility of the soil is maintained and increased by a proper retention of fallen leaves and other litter; *third;* the mechanical condition of the soil is improved; *fourth,* the lower part of the stems are shaded from the sun, and hence a complete system of natural pruning is provided for, and a generally superior quality of timber is the result. It is impracticable to plough, or dig, or manure the forest, but by preserving a close canopy of foliage in the plantation, a natural substitute is provided for the cultural operations mentioned. Natural pruning is more efficient and more economical than any scheme of artificial aid that can be devised. When trees are planted at 3 or 4 feet apart, all the lower branches, after they attain the length of 2 feet, begin to press upon one another, and check each other's growth. Then when the branches above close, and exclude the light, the lower ones die and drop off before they grow to a size sufficient to occasion appreciable defects in the timber. This is the only practicable system of pruning when dealing with plantations of large extent—say a thousand acres or more.

In managing plantations for timber purposes, the thinnings should be so moderate as to ensure the fulfilment of the conditions above indicated. A definite rule cannot be laid down as to when thinning should commence. The condition of the plantation only can decide this. There is, of course, a danger of the trees being *drawn up* too much, and their stems becoming too long and bare of branches for their girth, but by cautious and timely thinning, this danger can easily be averted. The margins of the plantations should always be more severely thinned, in the early stages of growth, than the rest of the wood. This is necessary in order that the trees may become well branched and firmly rooted, so as to be able to resist the force of the storms which so frequently sweep across the country, and occasion so much damage to the woods. In the after management of the plantations, the margins should be left entirely undisturbed.

XIX. *Arboriculture in the Counties of Dumfries, Kirkcudbright, and Wigtown.* By ALEXANDER PITCAITHLEY, Forester, Sudbourn Hall, Wickham Market, Suffolk.

The south-western district of Scotland, comprising the counties of Dumfries, Kirkcudbright, and Wigtown, is bounded on the south by the Solway Firth, Wigtown Bay, and Galloway Bay; on the west by the North Channel; on the north by the counties of Ayr and Lanark; and on the east by the county of Roxburgh. The extreme length from east to west is about one hundred miles, and the greatest breadth from north to south about fifty miles. The total area is about 2569 square miles, or 1,644,195 imperial acres, apportioned thus—Dumfriesshire, 705,946; Kirkcudbrightshire, 610,343; and Wigtownshire, 327,906 acres.

The general aspect is very hilly, with the exception of the level tracts of rich alluvial land along the valleys and estuaries of the rivers. Among the principal rivers are the Esk, Annan, and Nith, in Dumfriesshire; the Urr, Dee, and Cree, in Kirkcudbrightshire; and the Bladenoch, in Wigtownshire. The chief lochs are Loch Ken, in Kirkcudbrightshire; and Lochmaben, in Dumfriesshire.

The Lowther range of hills, and their outlying spurs, extend along the whole of the northern boundaries of these counties. The most elevated points are Mount Merrick, in Kirkcudbrightshire, 2764 feet high; and Hartfell, in Dumfriesshire, 2650 feet. Nearly all those hills are clothed to the summits with green grass, presenting a striking contrast to the heath-covered mountains in the northern parts of Scotland.

The soil is exceedingly variable, as is also the geological formation. In Dumfriesshire red sandstone predominates, and being of excellent quality, the quarries form a considerable item in the revenue of several estates. In Kirkcudbrightshire the granite formation prevails; and Cairnsmuir raises its rounded summit of smooth granite to a height of 2000 feet above sea-level.

The soil and climate are well adapted to the growth of timber. Oak, ash, beech, chestnut, sycamore, and all the other ordinary kinds of hardwoods are found growing to a great size, and still retaining their vigour. One of the largest oaks in Scotland grows on the side of the road on the estate of Carnsalloch in Dumfriesshire, while the other timber on the same estate is not equalled in the county for size, the soil here being a good loam resting on sandstone. Perhaps the finest avenue of limes to be found in Scotland stands at Kenmuir

Castle, in Kirkcudbrightshire, which is also famed for its beeches, scarcely surpassed anywhere for their size and symmetry. Many other beeches of large size are met with on several estates in Dumfriesshire, particularly in Annandale.

Yet, under such favourable conditions, arboriculture has not received the same amount of attention which has been paid to it in many other districts in Scotland. The total acreage under wood, according to the agricultural returns of 1882, in the three counties is — Dumfriesshire, 31,162; Kirkcudbrightshire, 19,714; and Wigtownshire, 8009 acres; or a total of 58,885 imperial acres.

The year following that on which these returns were made, the south of Scotland was visited by a series of terrific gales, on the 11th December 1883, and again on the 23rd and 24th January 1884, which caused great destruction of the woods on many estates in these counties, and have thus reduced the acreage of them by at least one-third. Those woods which suffered most were composed of the healthiest well-grown trees, and consequently they were most valuable. Nothing approaching this has been experienced since the disastrous gale of 7th January 1839, at which time the woods in the south of Scotland suffered, it was estimated, to the extent of more than £20,000.

On several of the larger estates the proprietors have paid considerable attention to their woodlands, particularly the Duke of Buccleuch, the Earl of Mansfield, and Sir Robert Jardine, Bart., in Dumfriesshire; the Earl of Selkirk, and Murray Stewart, Esq., in Kirkcudbrightshire; and the Earl of Stair, in Wigtownshire. On these and a few other estates, the forester's department is managed in a thoroughly systematic manner. There are, however, at the same time many medium sized and smaller estates possessing a considerable area of woodlands, where no experienced forester is kept, and where there is no proper or systematic management of the woods.

There is a fair proportion of the woodlands under hardwood, the majority of which, however, is aged; and, on the whole, there is a rather insufficient succession crop, as they have not been planted so profusely as is advisable. Where recently planted they have often been set along with fir, spruce, etc., as nurses, and afterwards left to themselves for several years, when the conifers have overgrown, and eventually destroyed the hardwoods.

The kinds of trees most extensively planted are pines (including several of the newer species), spruce, and larch. Of the pines, *Pinus austriaca*, *P. Laricio*, and *P. Pinaster* have done remarkably well; the *P. Pinaster* especially on light open soil near the Solway, where many good specimens of it are to be found.

Spruce has not been so extensively planted, although it thrives and grows well. *Abies Douglasii* has not been much planted as a forest tree, but where it has been inserted in a favourable soil, with moderate shelter, it has grown uncommonly well. One of the oldest, and probably among the largest, specimens in Scotland, stands on the lawn in the flower-garden at Jardine Hall, Dumfriesshire, and is a picture of health.

Larch has thriven well in former years, though that of recent planting has not done so well. The principal causes of failure are blight and blister, though in many cases it is traceable to being planted on stiff, retentive, clayey soils, altogether unsuitable to the successful growth of the larch.

Silver fir grows to a large size, and several are to be found over one hundred feet high, with large clean boles.

Considerable attention has been paid to the planting of Coniferæ of recent introduction, fine collections being found at nearly all the large mansions in the three counties. Perhaps the most comprehensive collection is to be found in the pinetum at Castle Kennedy, Wigtownshire, the property of the Earl of Stair, in which there are many rare and beautiful specimens. One of the finest collections of coniferous trees in Dumfriesshire lately stood at Lann Hall, but it was unfortunately destroyed by the storms of 1883-84. Any one visiting the counties will be astonished at the great amount of damage done by these storms to the woods. Where there previously stood many waving plantations, there is now to be seen nothing but upturned roots and broken trunks, with here and there a lonely survivor. While trees that had stood for ages were blown down, those which suffered most were from thirty to seventy years of age. Perhaps the greatest damage was done on the Duke of Buccleuch's estates. On the Langholm estate over 20,000 trees were upturned, and on Drumlanrig estate it was estimated that 120,000 trees were blown down in the December gale, and as many more on the 26th January. Several thousand pounds' worth of timber was also destroyed on Sir Robert Jardine's Castlemilk estate in Dumfriesshire; while Lord Selkirk's estate in Kirkcudbrightshire suffered the loss of 20,000 trees, and mostly every other estate suffered proportionally as great a loss.

So much fallen timber at one time caused a great glut in the market. It was mostly sold where it lay by private tender, and generally realised but indifferent prices, owing chiefly to the inextricable confusion in which the trees lay; good firs in many cases only realising a few pence per tree. There was not sufficient forethought exercised in this crisis, else proprietors would have had a large quantity of the fallen wood cut up into the lengths and sizes generally employed for estate purposes, and stored them away in open sheds, and thus saved the present heavy drain on many sadly depleted woodlands.

Severe as these storms were, I believe that four-fifths of the damage done might have been obviated had the plantations been judiciously managed from the beginning. In laying out the plantations on many estates there had been no attempt made to establish screens from the blast, which would have saved much of the damage; as I have noticed, particularly in Dumfriesshire, that where natural birch, etc., happened to be growing on the exposed side of a plantation, the damage done has been comparatively trifling.

Another source of damage from neglect was the absence of thorough drainage. Instances were to be found of plantations of from thirty to sixty years of age, the drains in which apparently had never received any attention since they were made. The grouud being swampy, the trees, though well grown, were necessarily surface rooted, and readily succumbed to the storm. The want of timely thinning was also the cause of a considerable amount of damage. In many cases the trees were crowded together, fifty to sixty feet in height, with long slender stems scarcely a foot in diameter. When once an opening was made these quickly yielded, and were either blown down or broken in the middle. The Scots fir plantations suffered most from this cause.

The prevailing winds are westerly; that of December 1883 was from the south-west, while those of January 1884 were from the west and north-west. The gale of 1839, however, was from the south-east.

Since these storms a number of proprietors have done a great deal to repair the condition of their woodlands; perhaps Sir Robert Jardine, Bart., more than most others. The plan adopted by Sir Robert was to trench out all the roots, which were afterwards collected into huge heaps and burned, and the ground replanted. This is undoubtedly the best system, but the great expense has deterred some from adopting it, while on many estates little or nothing has been done in the way of repairing the damage.

One great drawback to the more general development of the woods is the entire absence of home nurseries. As far as the writer is aware, there is no estate in the three counties in the possession of one. There are, however, excellent public nurseries at Annan, Dumfries, Maxwelltown, Stranraer, etc., where good collections of all kinds of forest trees are kept in stock. A common custom on many, and the general rule on small estates, is to have the planting executed by contract by nurserymen; the contract price to include plants and labour per acre, and the plantation to be upheld for three years, that is, the filling up of all blanks from *natural* causes. The general system adopted for all classes of trees is pit-planting; Scots fir, etc., being usually inserted at four years of age.

Ground game are too numerous on nearly every estate, and plantations suffer much from their ravages, the only effectual cure being wire netting, which consequently increases the expense. Yet, although the woods abound with squirrels, I have never noticed any damage done by them barking the trees, as is so common in the north of Scotland.

A ready sale is found for wood of good quality; ash, elm, and oak readily fetching from 2s. to 2s. 6d. per cubic foot. Clean larch of suitable size is in demand for boat-building, and commands a good price. Birch and alder might be more extensively grown, as there is always a ready sale for this class of wood locally to the cloggers. The usual prices of spruce and Scots fir is 6d. to 8d., and larch 1s. per foot.

Pruning hardwoods is very little practised, the result being that short boles with widely ramified limbs are the rule. This is the case particularly among hedgerow timber, and forms a cause of continual complaint by the agricultural tenant, and not without reason, as the spread of branches over the land renders, on some farms, several acres useless. In some instances the trees have had their lower branches cut off where they have interfered too much with the land, and in almost every case they have been amputated close to the trunk, causing a large wound, which in a few years entirely ruins the trees. The majority of this damaged class of timber when cut can be disposed of only to the bobbin-maker, usually realising from 4s. to 6s. per ton. Many of the trees are rendered useless even for this purpose, by having nails and staples driven into them by the farmers who are in the habit of using hedgerow trees as posts when repairing their fences. This bad custom is notoriously common in Dumfriesshire.

The fences are of various kinds. Red sandstone abounding on many estates, it has been used extensively in forming stone walls. Iron and wire, and also wood and wire, are commonly used. Wooden pailings are also numerous, more especially in Dumfriesshire. This is partly accounted for by the great quantity of wood that has been blown down in recent years, much of which has been used for this purpose, but more particularly by it being a fox-hunting district, where wire-fences would be troublesome as well as dangerous, and very few fences are met with over three feet high. Hedges have been planted extensively at one time, principally of hawthorn, and several good ones are seen where they have been well kept. Hedges have been generally used as dividing fences on the farms, and add considerably to their amenity. The customary system is to have them trimmed every fifth year, just before breaking up the lea-ground; five years rotation being the rule in cropping the land. This system of cutting hedges has the effect of damaging their usefulness and appearance, giving them a strong growing top with a poorly furnished bottom. They also suffer much by the sheep when eating the turnip crop; for although it is specified in most leases that the farmer shall net the hedges at this season, yet on very few estates is the clause attended to. On exposed grazing ground, where there is a scarcity or absence of belts of plantation, these neglected and overgrown hedges form a good shelter for stock, the only useful purpose they serve.

There is no part of Scotland better adapted to the growing of timber, and no district more in need of the friendly shelter of woods, especially in the northern parts of Dumfriesshire, and on the open wind-swept hills of Galloway. It is true that a few proprietors have done a considerable amount of planting, but landowners in general have not yet fully realised the importance and benefit of the extension of their woods. It is to be hoped that the visit of the Royal Scottish Arboricultural Society to the district this season will be the means of more effectually drawing the attention of landowners to this important department of estate management.

ABSTRACT of ACCOUNTS of the ROYAL SCOTTISH ARBORICULTURAL SOCIETY for YEAR Ending 31st DECEMBER 1891.

CHARGE.

Balance :—Cash in hand from last Account,			£32 15 9
Outstanding Subscriptions at 31st December 1890,		£134 4 4	
Less—Written off as irrecoverable, owing to Non-payment, Deaths, and Resignations,		58 16 6	
			75 7 10
I.	Subscriptions for year 1891, payable	£127 14 0	
	Less—Paid in 1890,	5 16 6	
			121 17 6
II.	Subscriptions payable in 1892 paid in 1891,		5 14 0
III.	Subscriptions, Life Members,		18 18 0
IV.	Donations and Advertisements,		14 14 6
	Balance of Operations on Bank Account,		25 16 1
			£295 3 8

DISCHARGE.

I.	Accounts paid :—		
	Printing, Stationery, Prizes, Office Rent, Postages, etc.,		£157 14 2
II.	Secretary's Salary,		30 0 0
	Balance :—		
	Arrears of Subscriptions Outstanding,	£53 17 4	
	1891 Subscriptions Outstanding,	50 18 6	
		£104 15 10	
	Cash in hand,	2 13 8	
			107 9 6
			£295 3 8

NOTE showing Income, abstracted from foregoing :—

Arrears of Subscriptions payable,	£75 7 10	
Current Year's Subscriptions payable,	121 17 6	
	£197 5 4	
Outstanding at end of Year, *see* Discharge,	104 15 10	
Difference, being amount of Cash received,		£92 9 6
1892 Subscriptions paid in 1891,		5 14 0
Life Members' Subscriptions,		18 18 0
Donations and Advertisements,		14 14 6
		£131 16 0

Edinburgh, 14*th January* 1892.—I have examined the above Statement, and have compared it with the vouchers and other instructions produced to me, and find the Account accurately stated and sufficiently vouched; the balance in hands of the Treasurer is Two pounds thirteen shillings and eightpence sterling (£2, 13s. 8d.). The Nett Funds of the Society as at 31st December 1891 amount to One hundred and one pounds two shillings sterling.

JOHN ORD MACKENZIE, *Auditor*.

APPENDIX.

Royal Scottish Arboricultural Society.

PATRON—HER MOST GRACIOUS MAJESTY THE QUEEN.

1.—FORMER PRESIDENTS.

Year.	
1854.	JAMES BROWN, Deputy-Surveyor of the Royal Forest of Dean.
1855.	Ditto, Wood Commissioner to the Earl of Seafield.
1856.	Ditto, ditto.
1857.	The Right Hon. THE EARL OF DUCIE.
1858.	The Right Hon. THE EARL OF STAIR.
1859.	Sir JOHN HALL, Bart. of Dunglass.
1860.	His Grace THE DUKE OF ATHOLE.
1861.	JOHN J. CHALMERS of Aldbar.
1862.	The Right Hon. THE EARL OF AIRLIE.
1863.	The Right Hon. T. F. KENNEDY.
1864.	ROBERT HUTCHISON of Carlowrie, F.R.S.E.
1865.	Ditto, ditto.
1866.	Ditto, ditto.
1867.	Ditto, ditto.
1868.	Ditto, ditto.
1869.	Ditto, ditto.
1870.	Ditto, ditto.
1871.	Ditto, ditto.
1872.	HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1873.	Ditto, ditto.
1874.	JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS. L. & E., Professor of Botany in the University of Edinburgh.
1875.	Ditto, ditto.
1876.	The Right Hon. W. P. ADAM of Blairadam, M.P.
1877.	Ditto, ditto.
1878.	Ditto, ditto.
1879.	The Most Hon. THE MARQUIS OF LOTHIAN, K.T.
1880.	Ditto, ditto.
1881.	Ditto, ditto.
1882.	ALEXANDER DICKSON, M.D., F.R.S.E., of Hartree, Regius Professor of Botany in the University of Edinburgh.
1883.	HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1884.	Ditto, ditto.
1885.	Ditto, ditto.

YEAR.

1886. Sir HERBERT EUSTACE MAXWELL, Bart., of Monreith, M.P.

1887. Ditto, ditto.

1888. The Right Hon. THE EARL OF HOPETOUN, Hopetoun House, Linlithgow.

1889. His Excellency The Right Hon. THE EARL OF HOPETOUN, Governor of Victoria, Australia.

1890. ISAAC BAYLEY BALFOUR, M.D., Sc.D., F.R.S., Professor of Botany in the University of Edinburgh.

1891. Ditto, ditto.

2.—LIST OF MEMBERS.

Corrected to March 1892.

Date of Election.

HONORARY MEMBERS.

1873. BRANDIS, Sir Dietrich, K.C.S.I., Ph.D., *Ex*-Inspector General of Forests in India, Bonn, Germany.

1868. BULLEN, Robert, Curator of the Botanic Garden, Glasgow.

1886. CAMPBELL, Sir James, Bart., Whitemead Park, Lydney, Gloucestershire.

1865. CLEGHORN, Hugh, M.D., LL.D., F.R.S.E., Stravithie, St Andrews, Fife (also a *Life* Member by composition).

1886. HOOKER, Sir Joseph D., M.D., K.C.S.I., The Camp, Sunningdale, Berks.

1864. HUTCHISON, Robert, F.R.S.E., of Carlowrie, University Club, Edinburgh.

1886. JACK, Edward, St John, New Brunswick.

1886. JOHORE, The Maharajah of, Johore, Malay Peninsula.

1856. LAWSON, George, LL.D., Ph.D., Secretary for Agriculture, Government of Nova Scotia, Halifax, Nova Scotia.

1869. LOTHIAN, The Most Hon. the Marquis of, K.T., Secretary of State for Scotland, Newbattle Abbey, Dalkeith (also a *Life* Member by composition).

1886. LUBBOCK, Sir John, Bart., M.P., D.C.L., High Elms, Down, Kent.

1886. MICHAEL, General, C.S.I., Ascot.

1889. SARGENT, Professor C. S., Director of the Arnold Arboretum, Harvard College, Brookline, Massachusetts, U.S.A.

1889. SCHLICH, Dr William, Professor of Forestry in the Engineering College for India, Cooper's Hill, Surrey.

1886. SOUTHEY, Hon. Robert, Cape Town.

1881. TEMPLE, Sir Richard, Bart., G.C.S.I., The Nash, Worcestershire.

1886. TOKAI, Tokio, Japan.

Date of Election.

LIFE MEMBERS.

1875. ACLAND, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter.
1883. ADAM, Sir Charles Elphinstone, Bart. of Blairadam, Kinross-shire.
1874. ADDINGTON, The Right Hon. Lord, Addington Manor, Winslow, Bucks.
1883. ALEXANDER, John, Assistant Conservator of Forests, Kandy, Ceylon.
1883. ATHOLE, His Grace the Duke of, K.T., Blair Castle, Blair Athole.
1887. BAILEY, Colonel F., R.E., Lecturer on Forestry, Edinburgh University, 9 Wemyss Place, Edinburgh.
1884. BALFOUR OF BURLEIGH, The Right Hon. Lord, Kennet House, Alloa.
1886. BALFOUR, Edward, of Balbirnie, Markinch, Fife.
1877. BALFOUR, Isaac Bayley, Sc.D., M.D., F.L.S., Professor of Botany, Edinburgh.
1866. BARRIE, James, Forester, Stevenstone, Torrington, North Devon.
1877. BARRY, John W., of Fyling Hall, Fylingdales, Scarborough.
1884. BATES, Cadwallader John, of Heddon and Langley Castle, Northumberland.
1870. BAYNE, Lewis, Jeannie Bank, Perth.
1871. BELL, William, of Gribdae, Kirkcudbright.
1875. BERTRAM, William, Ellengowan Villa, Newington, Edinburgh.
1877. BOLCKOW, C. F. H., of Brackenhoe, Middlesboro'-on-Tees.
1882. BRUCE, Hon. Robert Preston, M.P., Broomhall, Dunfermline.
1871. BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
1867. BRUCE, Thomas Rae, of Slogarie, New Galloway Station.
1879. BUCCLEUCH, His Grace the Duke of, K.T., Dalkeith Park, Dalkeith.
1879. BUCHANAN, Charles, Overseer, Penicuik House, Penicuik.
1882. CHOWLER, Christopher, Gamekeeper, Dalkeith Park, Dalkeith.
1890. CHRISTIE, John, of Cowden, Dollar.
1877. CLAY, J. Spender, Ford Manor, Lingfield, Surrey.
1872. CLERK, Sir George D., Bart., Penicuik House, Penicuik.
1879. COLQUHOUN, Andrew, Forester, Rossdhu, Luss, Dumbartonshire.
1876. COWAN, Charles W., of Logan House, Valleyfield, Penicuik.
1892. COWAN, George, 1 Gillsland Road, Edinburgh.
1875. CRAIG, Wm., M.D., C.M., F.R.S.E., 71 Bruntsfield Place, Edinburgh.
1865. CROSS, David G., Forester, Kylisk, Nenagh, Ireland.
1880. CURR, Henry, Factor, Pitkellony House, Muthill, Perthshire.
1884. CURRIE, Sir Donald, K.C.M.G., M.P., of Garth Castle, Aberfeldy.
1867. DALGLEISH, John J., of Ardnamurchan, 8 Athole Crescent, Edinburgh.
1876. DALGLEISH, Laurence, of Dalbeath, 8 Athole Crescent, Edinburgh.
1877. DEWAR, Daniel, Forester, Beaufort Castle, Beauly.
1883. DUNDAS, Charles H., of Dunira, Dalhonzie, Crieff.
1872. DUNDAS, Robert, of Arniston, Gorebridge.
1867. DUNN, Malcolm, The Palace Gardens, Dalkeith.
1875. EASTWOOD, James, The Gardens, Bryn-y-Newadd, Bangor, North Wales.
1876. EDWARDS, William Peacock, S.S.C., 21 Hill Street, Edinburgh.
1881. ELLIOT, Walter, Manager, Ardtornish, Morvern, Oban.
1879. FALCONER, Dr John, St Ann's, Lasswade.

Date of Election.

1891. Farquharson, A. J., F.H.A.S., Newtyle, Forfarshire.
1888. Ferguson, R. C. Munro, M.P., of Raith and Novar.
1869. Fish, D. T., Hardwick House, Bury St Edmunds.
1874. Fitzwilliam, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
1885. Fleming, J. B., "Beaconsfield," Kelvinside, Glasgow.
1881. Forbes, Arthur Drummond, Millearne, Auchterarder, Perthshire.
1890. Forbes, William, Swinton, Masham, Yorkshire.
1866. France, Charles S., 11 Bridge Street, Aberdeen.
1856. Gough, William, Wood Manager, Wykeham, York.
1884. Graham, Wm., of Erins, Tarbert, Lochfyne.
1874. Grant, John, Overseer, Daldowie, Tollcross.
1880. Grant, Sir George Macpherson, Bart., M.P., Ballindalloch Castle, Banffshire.
1867. Grimond, Alexander D., of Glenericht, Blairgowrie.
1880. Hare, Colonel, 32 Palmerston Place, Edinburgh.
1874. Herbert, H. A., of Muckross, Killarney.
1884. Heywood, Arthur, Sudbourne Hall, Wickham Market, Suffolk.
1871. Hope, H. W., of Luffness, Drem.
1876. Horne, John, Director, Forests and Gardens, Mauritius.
1876. Horsburgh, John, 131 Princes Street, Edinburgh.
1869. Huth, Louis, of Possingworth, Hawkhurst, Sussex.
1884. Inglis, Alex., Tyninghame, Prestonkirk.
1880. Jenner, Charles, Easter Duddingston Lodge, Edinburgh.
1882. Jonas, Henry, Land Agent and Surveyor, 4 Whitehall, London, S.W.
1890. Kennedy, James, The Chesters, New Kilpatrick, near Glasgow.
1876. Leicester, The Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
1868. Leslie, Charles P., of Castle-Leslie, Glasslough, Ireland.
1874. Leslie, The Hon. George Waldegrave, Leslie House, Leslie, Fife.
1883. Loney, Peter, Estate Agent, Marchmont, Duns.
1881. Lonsdale, Claud, Rose Hill, Carlisle.
1880. Love, J. W., c/o Mrs Boyce, Byron Street, St Kilda, Victoria, South Australia.
1875. Lovelace, The Right Hon. the Earl of, East Horsley Towers, Woking, Surrey.
1881. Lumsden, David, of Pitcairnfield, Perth.
1891. Lumsden, Hugh Gordon, of Clova, Lumsden, Aberdeenshire.
1875. Luttrell, George F., of Dunster Castle, Taunton, Somersetshire.
1874. Macdonald, Ranald, Factor, Cluny Castle, Aberdeenshire.
1876. M'Dougall, Captain J. W., jun., of Orchill, Braco, Perthshire.
1884. Macduff, Alex., of Bonhard, Perth.
1879. M'Intosh, Dr W. C., Professor of Natural History, University of St Andrews, 2 Abbotsford Crescent, St Andrews.
1882. M'Kenzie, Alex., Superintendent of Epping Forest, The Warren, Loughton, Essex.
1869. Mackenzie, Colin J., of Portmore, Eddleston, Peebles.
1872. Mackenzie, Donald F., Estate Office, Morton Hall, Edinburgh.

Date of Election.

1880. Mackenzie, Sir Kenneth, Bart., Conon House, Dingwall.
1879. M'Laren, John, jun., Marionville, Sciennes Gardens, Edinburgh.
1879. MacRitchie, David, C.A., 4 Archibald Place, Edinburgh.
1857. MacTier, A. W., "Rothesay," Bournemouth, Hants.
1880. Malcolm, Lieut.-Col. E. D., R.E., 18 Queen's Gate Place, London, S.W.
1871. Maxwell, Wellwood H., of Munches, Dalbeattie.
1880. Mesham, Captain, Pontryffydd, Bodvari, Rhyl.
1881. Michie, John, Forester, Balmoral, Ballater.
1882. Mitchell, Francis, Forester, Harleston, Northamptonshire.
1889. Moffat, James, Assistant Factor, 48 Castle Street, Edinburgh.
1881. Naylor, Christopher John, Brynellywarch, Kerry, Montgomeryshire.
1856. Portsmouth, The Right Hon. the Earl of, Eggesford, North Devon.
1887. Profeit, Dr Alexander, Her Majesty's Commissioner, Balmoral.
1878. Punchard, Frederick, Underley Estate Office, Kirkby Lonsdale, Westmoreland.
1855. Ramsden, Sir John, Bart., 6 Upper Brook Street, London, W.
1876. Ritchie, William, of Middleton, Gorebridge, Edinburgh.
1866. Robertson, James, Wood Manager, Panmure, Carnoustie.
1890. Robinson, William, 37 Southampton Street, Strand, London.
1883. Rollo, The Hon. Wm. Chas. Wordsworth, Master of Rollo, Duncrub Park, Dunning, Perthshire.
1872. Rosebery, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
1854. Rutherford, James, Agent, Kirkleatham, Redcar, Yorkshire.
1867. Scott, Daniel, Wood Manager, Darnaway, Forres.
1877. Smith, Thomas Valentine, of Ardtornish, Morvern, Argyleshire.
1882. Smythe, David M., yr. of Methven Castle, Perth.
1889. Somerville, Dr William, B.Sc., F.R.S.E., Professor of Agriculture and Forestry, Durham College of Science, Newcastle.
1883. Sprot, Major Alexander, of Garnkirk.
1883. Stafford, The Most Hon. the Marquis of, M.P., Dunrobin Castle, Golspie.
1873. Stair, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
1883. Stormont, The Right Hon. Viscount, Scone Palace, Perth.
1880. Sutherland, Evan C., of Skibo Castle, Dornoch.
1865. Talbert, Peter, Forester, Glenericht, Blairgowrie.
1877. Terris, James, Factor, Dullomuir, Blairadam, Kinross-shire.
1880. Thomson, Alexander, Trinity Grove, Trinity Road, near Edinburgh.
1855. Thomson, John Grant, Wood Manager, Grantown, Strathspey.
1883. Trotter, Colonel H., of Morton Hall, Edinburgh.
1872. Trotter, Colonel, R.A., The Bush, Edinburgh.
1872. Urquhart, B. C., of Meldrum, Aberdeenshire.
1878. Walker, Major I. Campbell, Conservator of Forests, Forest Office, Madras.
1871. Wemyss, Randolph Gordon Erskine, of Wemyss and Torrie, Fife.
1869. Wild, Albert Edward, Conservator of Forests, Punjab, India.
1889. Wilson, David, jun., of Carbeth, Killearn.

ORDINARY MEMBERS.

The Names printed in italics are those of Members whose present Addresses are unknown. Any information regarding these Members will be gladly received by the Secretary.

LAW V. Members in arrear shall not receive the *Transactions* while their Subscriptions remain unpaid. Any Member whose Annual Subscription to the Society remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till he shall have paid up his arrears.

Date of Election.

1882. AHLBOTTN, Nathaniel, Tree Protective Composition Manufacturer, 50 Shore, Leith.

1881. AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.

1878. AITKEN, Andrew Peebles, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.

1891. ALEXANDER, James, Gardener and Forester, Revesby Abbey, Boston, Lincolnshire.

1865. ALLAN, John, Forester, Dalmeny Park, Edinburgh.

1883. ANDERSON, David, Forester, Jardine Hall, Lockerbie.

1887. ANNAND, Adam, Forester, Brucklay Castle, Aberdeenshire.

1887. ANNAND, John F., Assistant Forester, Brucklay Castle, Aberdeenshire.

1872. ANNANDALE, Robert B., Adderley Lodge, Market Drayton, Shropshire.

1883. ARGYLL, His Grace the Duke of, K.T., LL.D., D.C.L., F.R.S., F.G.S., Inverary Castle, Argyleshire.

1860. AUSTIN & M'ASLAN, Nurserymen, Buchanan Street, Glasgow.

1880. BALDEN, John, Dilston, Corbridge-on-Tyne, Northumberland.

1880. BALDEN, Robert S., Wood Manager, Castle Howard, York.

1886. BALFOUR, John, of Balbirnie, Markinch, Fife.

1889. BALFOUR, John, Gardener, Stravithie, St Andrews.

1888. BARLASS, James, Ironmonger, High Street, Perth.

1867. BARRIE, David, Forester, Comlongan Castle, Annan.

1882. BARRIE, John, Land Steward, Gateforth Hall, Selby, Yorkshire.

1889. BARRON, John, Elvaston Nurseries, Borrowash, near Derby.

1874. BARTON, James, Forester, Hatfield House, Herts.

1871. BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.

1883. BELL, Andrew, Forester, Broomhall, Charlestown, Fife.

1866. BELL, James, The Gardens, Stratfieldsaye, Winchfield, Hants.

1890. BERRIDGE, W., Sandy Cross, Bromyard, Worcester.

1889. BERRY, Francis, Forester, Culquoich, Inverkindie, Aberdeenshire.

1869. BISSETT, William S., Overseer, Moncrieffe House, Perth.

Date of Election.

1889. Blair, Peter, Gardener, Trentham, Stoke-on-Trent.
1883. Blake, Jas., Forester, Morton Hall, Edinburgh.
1854. Boa, Andrew, Land Steward, Dalton House, Newcastle-on-Tyne.
1872. Boa, Andrew, jun., Sub-Agent, Great Thurlow, Newmarket, Suffolk.
1876. Booth, John, 114 Kurfursteadain, Berlin.
1857. Borthwick, William, Forester, Dunnichen, Forfar.
1887. Boulger, Professor, 18 Ladbroke Grove, London.
1883. Boyd, John, Forester, Pollok Estate, Pollokshaws, Glasgow.
1889. Britton, Horatio A., Timber Valuer, 6 Birch Street, Wolverhampton.
1860. Brodie, James, Land Steward, Glasslough, Armagh, Ireland.
1881. Brodie, Vernon Alex., Civil Service, Madras.
1878. Brown, J. A. Harvie, of Quarter, Dunipace House, Larbert.
1868. Brown, John E., F.L.S., Conservator of Forests, Forest Board Office, Adelaide, South Australia.
1887. Brown, J. R., Wentworth Nurseries, Hexham.
1889. Brown, P. S., Tayview, Broughty Ferry.
1883. Browning, John M., The Gardens, Dupplin Castle, Perth.
1885. Bruce, Thomas, Assistant Forester, Cross Roads, Kinnell, Friockheim.
1873. Brydon, John, Forester, Rothes, Elgin.
1873. Buchan, Alexander, A.M., F.R.S.E., Secretary of the Scottish Meteorological Society, 72 Northumberland Street, Edinburgh.

1887. Cadell, George, 22 Great George Street, Westminster, London.
1870. Cameron, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
1890. Campbell, Alexander, of Auchindarroch, Lochgilphead.
1889. Campbell, Colin, Agent, Bretby Park, Burton-on-Trent.
1865. Campbell, James, of Tillichewan Castle, Dumbartonshire.
1883. Campbell, John Macnaught, C.E., F.L.S., Assistant Curator, City Museum, Kelvingrove Park, Glasgow.
1884. Christie, Alex. D., The Gardens, Ragley, Alcester, Warwickshire.
1883. Christie, William, Nurseryman, Fochabers.
1887. Clark, Alexander, 226 High Street, Linlithgow.
1890. Clark, Charles, Forester, Cawdor Castle, Nairn.
1872. Clark, David, Forester, Elie House, Elie, Fife.
1866. Clark, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
1891. Clark, John, Forester, Haddo House, Aberdeen.
1890. Cockburn, Philip, Dalkeith.
1882. Collins, Robt. T., Forester, Trentham, Stoke-on-Trent, Staffordshire.
1887. Cook, Alfred, Forester, Empingham, Stamford.
1887. Cook, James, Land Steward, Arniston, Gorebridge.
1890. Cooke, R. W., of Messrs Dunning & Cooke, Newcastle.
1879. Coupar, Robert, Forester, Ashford, Cong, County Galway.
1858. Cowan, James, Forester, Bridgend, Islay.
1872. Cowie, John, Assistant Forester, Mountstuart, Rothesay.
1874. Cowper, R. W., Gortanore, Sittingbourne.
1875. Crabbe, David, Forester, Cortachy Castle, Kirriemuir.
1867. Crabbe, James, Forester, Glamis Castle, Forfarshire.

Date of Election.

1876. Cromb, James, Assistant Forester, Kelly Castle, Arbirlot, Arbroath.
1887. *Cumming, Allan, Forester, Milldeans, Kennoway, Fife.*
1868. Cunningham, John, Forester, Ardross, Alness, Ross-shire.

1891. Daglish, John, Rothley Lake, Cambo R. So. Northumberland.
1884. Dalziel, James, Forester, Culzean Castle, Maybole, Ayrshire.
1869. Daniels, Peter, Forester, Slindon Hall, Arundel, Sussex.
1874. Davidson, George, Land Steward, Walton, Linlithgow.
1865. Davidson, John, Agent, Greenwich Hospital Estates, Haydon Bridge, Northumberland.
1857. Davidson, John, Forester, Aldbar, Brechin.
1884. Deane-Drake, Joseph Edward, Stokestown House, New Ross, Ireland.
1868. *Dodds, George, Overseer, Rotherham Woods, Rotherham.*
1889. Don, John, Seedsman, Chapel Bar, Nottingham.
1891. Donald, A. S., Forester, Philiphaugh, Selkirk.
1884. Doughty, Wm., Forester, Langholm Estate, Canonbie, Dumfriesshire.
1887. Douglas, Robert, 64 Princes Street, Edinburgh.
1882. Douglas, Captain Palmer, of Cavers, Hawick.
1867. Dow, Thomas, Forester, Bretby, Burton-on-Trent.
1889. Drummond, Robert, Road Surveyor, Midcalder.
1862. Drummond & Sons, William, Nurserymen, Stirling.
1866. Duff, James, Factor, Blackwood, Lesmahagow.
1875. Duncan, James, Land Steward, Glack, Old Meldrum.
1889. Duncan, J. W., Somerville Place, Broughty Ferry.
1873. Durward, Robert, Manager, Blelack, Dinnet, Aberdeenshire.

1885. *Eddington, Francis, Forester, Windlestone, Ferryhill, County Durham.*
1887. Erskine, William, of Oaklands, Trinity.
1873. Ewing, David, Forester, Strichen House, Aberdeen.

1880. Fergusson, Sir James Ranken, Bart., Spitalhaugh, West Linton.
1872. Fingland, John, Forester, Drumlanrig, Thornhill, Dumfriesshire.
1891. Firth, W. M., Timber Merchant, 19 Montpelier, Edinburgh.
1869. Fisher, William, Estate Agent, Wentworth Castle, Barnsley, Yorkshire.
1884. Fleming, John, Albert Saw-Mills, Aberdeen.
1890. Forbes, Arthur C., Wood Manager, Bowood, Calne, Wiltshire.
1878. Forbes, Robert, Overseer, Clova, Lumsden, Aberdeenshire.
1891. Foreman, Frederick, Nurseryman, Eskbank, Dalkeith.
1884. Forrest, Thomas, Assistant Forester, Dalzell Home Farm, Motherwell.
1883. Forrest, Sir William J., Bart. of Comiston, Edinburgh.
1889. Forster, William A., Forester, Belgrave Lodge, Pulford, Wrexham.
1878. Forsythe, John M., Wood Manager, Woburn, Bedfordshire.
1884. Foulis, Thomas, Publisher, 9 South Castle Street, Edinburgh.
1857. Fraser, P. Neill, of Rockville, Murrayfield, Edinburgh.

1878. Galletly, James, Overseer, Bonhard, Perth.
1874. Galloway, George, Estate Offices, Woodhouses, Whitchurch, Salop.
1885. Gibb, James, Assistant Forester, Kinnaird Castle, Brechin.

Date of Election.

1870. Gilbert, James, Forester, Gallovie, Kingussie.
1887. Gilbert, W. Matthews, The *Scotsman* Office, Edinburgh.
1881. Gilchrist, William, Forester, Leuchars, Elgin.
1876. Glassbrook, Geo., Bailiff, Remenham Farm, Henley-on-Thames, Bucks.
1880. *Glen, David A., Assistant Forester, Swinton, Masham, Yorks.*
1887. *Gomersall, Edward, Forester, Moor Crichel, Wimborne, Dorset.*
1891. Gorrie, G. H., Estate Office, Dalkeith.
1868. Gossip, James, of Howden & Co., The Nurseries, Inverness.
1882. Gow, Robt., Assistant Forester, Raith, Kirkcaldy, Fifeshire.
1887. Grant, Alexander, Assistant Forester, Edensor, Chatsworth, Derbyshire.
1882. Grant, Alex. M'D., Assistant Forester, Newton, Winchburgh.
1867. Grant, Donald, Forester, Drumin, Ballindalloch.
1873. Grant, James, Forester, Heath, Chesterfield.
1883. Green, Arthur A., 20 Annandale Street, Edinburgh.
1890. Greenwood, C. H., Assistant Forester, Hamels Park, Buntingford, Herts.
1872. Greive, James, Messrs Dicksons & Co.'s Nurseries, Pilrig, Edinburgh.
1888. Grieve, James, Waterloo Hotel, Edinburgh.

1879. Haddington, the Right Hon. the Earl of, Tyninghame, Prestonkirk.
1880. Haddon, Walter, Solicitor, Royal Bank, Hawick.
1881. Hadfield, Gordon, Forest Department, Madras.
1882. Hamilton, Donald C., Forester, Bargany Mains, Girvan, Ayrshire.
1873. Hamilton, John B. Baillie, of Arnprior, Cambusmore, Callander.
1889. Hankins, Charles, Forester, Grimsthorpe, Bourne.
1887. Hansen, Professor Carl, Royal Agricultural College, Copenhagen.
1890. Hardie, James F., Forester, Donibristle, Aberdour.
1891. Hardie, J. W., 12 Baltic Street, Leith.
1872. Hartland, Richard, The Lough Nurseries, Cork.
1888. Harwell, John Hood, Overseer, Whitemoss, Kirknewton.
1880. Havelock, W. B., Forester, Duncombe Park, Helmsley, York.
1889. Hayes, John, Overseer, Dormont, Lockerbie.
1869. Hayman, John, Queenshill, Ringford.
1866. Henderson, Arch., Forester, Clonad Cottage, Tullamore, King's County.
1871. Henderson, John, Overseer, Vogrie, Ford, Dalkeith.
1883. Henderson, W., The Gardens, Balbirnie, Markinch.
1878. Henry, Kennedy, Forester, Craighall, Rattray, Blairgowrie.
1871. Hetherton, Walter, Forester, Merton, Beaford, Devon.
1886. Hodson, Richard Edmund, Hollybrooke, Bray, Co. Wicklow, Ireland.
1866. Hogarth, James, Forester, Culhorn, Stranraer.
1884. Hogg, Andrew, Forester, Castle Fraser, Kemnay, Aberdeenshire.
1887. Holmes, Joseph, The Gardens, Winton Castle, Pencaitland.
1874. Home, Edward, Assistant Forester, Edington, Chirnside.
1872. Home, George, Forester, Branxholme, Hawick.
1880. Hopetoun, His Excellency The Right Hon. the Earl of, Governor of Victoria, Australia.
1876. Hull, Frank, Forester, Lilleshall, Newport, Salop.

Date of Election.

1891. Inglis, William, Forester, Brodick, Arran.

1870. Ireland & Thomson, Nurserymen and Seedsmen, 81 Princes Street, Edinburgh.

1886. Irvine, Daniel, Overseer, Glendevon House, Dollar.

1887. Jack, Donald, Forester, Pellipar, Dungiven, Londonderry.

1883. Johnston, Robert, Forester, Somerley, Ringwood, Hants.

1878. Johnstone, Adam, Forester, Coollattin, Shillelagh, County Wicklow.

1888. Jones, James, Wood Merchant, Larbert.

1867. Kay, James, Wood Manager, Bute Estate, Rothesay.

1880. Keay, Robert B., Findon Estates Office, Conon Bridge.

1870. Keir, David, Forester, Ladywell, Dunkeld.

1876. Kelman, John, Forester, Glenkindie, Aberdeen.

1882. Kennedy, John, Forester, Flakebridge, Appleby, Westmoreland.

1882. Kennedy, Walter, Forester, New Tarbet, Parkhill, Ross-shire.

1872. Kennedy, William, Overseer, Glen Carradale, Greenock.

1887. Ker, R. D., Writer to the Signet, 50 George Street, Edinburgh.

1870. Kidd, James B., Forester, Dunrobin Estates, Golspie.

1879. Kincairney, The Hon. Lord, 6 Heriot Row, Edinburgh.

1883. Kinnear, Alex., Forester, Galloway House, Garlieston.

1884. Knox, Henry, Forester, Brae Lodge, Maybole, Ayrshire.

1876. Kyrke, R. V., of Penywern, Mold.

1890. Laidlaw, William, Forester, Rochsoles Estate, Airdrie, Lanarkshire.

1886. *Laidlaw, William, Forester, Fasque, Lettercairn.*

1890. Laird, David Pringle, of R. B. Laird & Sons, 17 Frederick Street, Edinburgh.

1885. Laird, James W., of W. P. Laird & Sinclair, 73 Nethergate, Dundee.

1873. Lauriston, Alexander, Rufford Nursery, Ollerton, Newark.

1874. Leigh, William, of Woodchester Park, Stonehouse, Gloucestershire.

1880. Leishman, John, Manager, Cavers Estate, Hawick.

1879. Lindsay, Robert, Curator, Royal Botanic Garden, Edinburgh.

1883. Loch, Sir Henry B., K.C.B., Governor of Cape Colony, South Africa.

1872. M'Coll, James M., Factor, Craignish Castle, Lochgilphead, Argyleshire.

1870. M'Corquodale, D. A., Bank of Scotland, Carnoustie.

1855. M'Corquodale, Donald, Forester, Dunrobin Castle, Golspie.

1890. M'Crae, Alexander, c/o Mrs Christie, Lynedoch Road, New Scone, Perth.

1887. M'Culloch, James, Forester, Gala House, Galashiels.

1869. M'Cutcheon, Robert, Forester, Whittinghame, Prestonkirk.

1890. M'Donald, James, Gardener, Foulis Castle, Ross-shire.

1879. M'Dougall, Alex., Forester, Drumbuie Lodge, Dunkeld.

1889. *M'Dougall, Alexander, Assistant Forester, Cumbernauld Estate, Glasgow.*

1882. M'Farlane, John, Forester, Tarbet, Loch Lomond.

1890. M'Gee, John, Assistant Forester, Bute Estate, Rothesay.

1889. M'Gibbon, Adam, Forester and Overseer, Argaty, Doune.

1871. M'Grath, Patrick, Forester, Galtee Castle, Mitchelstown, Tipperary.

Date of
Election.

1890. M'Gregor, A., The Schoolhouse, Penicuik.
1878. M'Gregor, Duncan, Forester, Camperdown, Dundee.
1880. M'Intosh, A. G., Forester, Brocklesby Park, Ulceby, Lincolnshire.
1885. MacIntosh, William, Idvies, Forfar.
1882. M'Intyre, John, Wood Merchant, Cardross, Dumbartonshire.
1884. M'Kay, James, Forester, Breadalbane Estates, Killin.
1875. Mackay, John, Lauderdale Estate Office, Wyndhead, Lauder.
1887. Mackay, Peter, Assistant Forester, Rochsoles, Airdrie.
1891. Mackendrick, James, Forester, Brodie Castle, Forres.
1867. Mackenzie, Alex., Warriston Nursery, Inverleith Row, Edinburgh.
1882. Mackenzie, Sir Alex. Muir, Bart. of Delvine, Dunkeld.
1867. Mackenzie, John Ord, of Dolphinton, W.S., 9 Hill Street, Edinburgh.
1882. Mackie, James H. J., Land Steward, Invermay, Dunning, Perthshire.
1883. M'Kinnon, George, The Gardens, Melville Castle, Lasswade.
1878. Mackintosh, The, of Mackintosh, Moy Hall, Inverness.
1879. M'Laren, Charles, Land Steward, Cally Lodge, Dunkeld.
1878. M'Laren, John T., Overseer, Kennet, Alloa.
1867. M'Lean, Andrew, Forester, Rutherford, Roxburgh.
1866. M'Lean, William, Forester, Eglinton Castle, Irvine.
1865. M'Lellan, Duncan, Superintendent of Parks, 7 Kelvingrove Terrace, Glasgow.
1882. M'Lellan, Robt., 5 Dowan Vale Terrace, Partick.
1874. M'Leod, Angus A., Superintendent of City Gardens, 14 Royal Exchange, Edinburgh.
1883. M'Leod, John, of Dickson & Turnbull, 26 George Street, Perth.
1884. Main, Adam, Assistant Forester, Cluny Castle, Aberdeen.
1876. Martin, James, Forester, Knipton, Grantham, Lincolnshire.
1884. Massie, William H., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1886. Maxwell, Sir Herbert E., Bart. of Monreith, M.P., Wigtownshire.
1891. Maxwell, James, Assistant Forester, Bellstane, Drumlanrig.
1879. Meikle, R. A., Ri Cruin, Lochgilphead.
1889. Melville, The Right Hon. Viscount, Melville Castle, Lasswade.
1891. Menzies, A. M'G., The Nurseries, Larchfield, Dumfries.
1873. Menzies, George, Agent, Trentham, Stoke-on-Trent.
1863. Methven, Henry, of Thomas Methven & Sons, 15 Princes Street, Edinburgh.
1863. Methven, John, of Thomas Methven & Sons, Leith Walk Nurseries, Edinburgh.
1865. Michie, Christopher Young, Forester, Cullen House, Banffshire.
1889. Miller, William, Assistant Agent, Coombe Abbey, Coventry.
1882. Milne, Alexander, of James Dickson & Sons, 32 Hanover Street, Edinburgh.
1891. Milne, R. W., Assistant Forester, Lynedoch, Perth.
1890. Milne, William, Foulden, Berwick-on-Tweed.
1869. Mitchell, James, Aldie Castle, Kinross.
1876. Mitchell, John, Forester, Bolton Abbey, Skipton, Yorks.
1889. Mitchell, William, Brantinghampthorpe, Brough, Hull.
1876. Morgan, George, Wood Merchant, Turret Bank, Crieff.

Date of Election.

1890. Muirhead, George, Factor, Haddo House, Aberdeen.
1866. Muirhead, John, Forester, Bicton, Budleigh Salterton, Devonshire.
1890. Munro, Donald, Forester, Cool, Ross-shire.
1876. Munro, Hugh, Forester, Holkham Hall, Norfolk.
1883. Murray, John, Assistant Forester, Murthly Castle, Perthshire.

1885. Newbigging, John W., Nurseryman, Dumfries.
1869. Nicol, W. R., Forester, Kilkerran, Maybole.
1891. Nicoll, John, 48 Castle Street, Edinburgh.

1875. Page, Andrew Duncan, Land Steward, Culzean, Maybole.
1857. Palmer & Son, John, Nurserymen, Annan.
1857. Parker, James, Forester, Belvoir Castle, Grantham.
1890. Paterson, W. G., Timber Merchant, Invergordon.
1879. Paton, Hugh, Nurseryman, Kilmarnock.
1889. Patterson, Colin M., Resident Factor, Newbattle Park, Dalkeith.
1887. Paxton, Thomas A., Forester, Newbattle, Dalkeith.
1869. Peebles, Andrew, Estate Office, Albury, Guildford, Surrey.
1871. Pendreigh, John, Assistant Forester, Port Bannatyne, Rothesay.
1878. Pitcaithley, Alexander, Forester, Sudbourne Hall, Wickham Market, Suffolk.
1874. Platt, Colonel Henry, Gorddinag, Langairfechan, near Bangor.
1888. *Prater, T. Herbert, Canford Estate Office, Wimbourne, Dorset.*
1883. Preston, Wm. M., Estate Office, Barron Hill, Beaumaris.

1876. Rae, William Alexander, Murthly Castle, Perthshire.
1888. Ralston, James, Forester, Castlecary, Glasgow.
1886. Ramage, J. L., Assistant Forester, Armsheugh, Grougar, Galston.
1870. Rattray, Thos., Forester, Westonbirt House, Tetbury, Gloucestershire.
1873. Richardson, Adam, Royal Botanic Garden, Edinburgh.
1877. Rider, William H., 14 Bartholomew Close, London, E.C.
1884. Robertson, A. B., Moncrieffe House, Bridge of Earn.
1879. Robertson, Donald, Forester, Novar, Evanton, Ross-shire.
1882. Robertson, James, Assistant Forester, Chatsworth, Bakewell, Derbyshire.
1890. Robertson, J. S., Cawdor Estate Office, Nairn.
1883. Robertson, William, Assistant Forester, Ringwood, Birnam.
1887. Robertson, William, Assistant Forester, Scone, Perth.
1890. Robertson, William, Assistant Forester, Novar, Ross-shire.
1888. Robson, John, Assistant Forester, Ardgowan Castle, Inverkip, Renfrewshire.
1887. Ross, John, Forester, Hopetoun, South Queensferry.
1867. Russell, John, Manager, Craigie House, Ayr.
1872. Rust, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
1870. Rutherford, John, Forester, Linthaugh, Jedburgh.

1858. Sandbach, Henry R., Hafodunos, Abergele.
1875. Sang, Edmund, of E. Sang & Sons, Nurserymen, Kirkcaldy.
1871. Scarth, T. W., Land Agent, Raby Castle, Staindrop, Darlington.

Date of Election.

1870. Scott, Adam, Forester, Southwick Park, Fareham, Hants.
1883. Scott, D. P., Hilltown Branch National Bank of Scotland, Dundee.
1881. Scott, James, Forester, Woollaton Hall, Notts.
1890. Scott, John, Assistant Forester, Hornley, near Lancaster.
1883. Scott, William, Assistant Forester, Blairhill, Dollar.
1890. Scrimgeour, John, Assistant Forester, Lynedoch, Perth.
1870. Shanks, John, Forester, Kildrummy Castle, Mossat, Aberdeenshire.
1891. Shaw, James, Gardener, Belladrum, Beauly.
1887. Simpson, Anthony, Assistant Forester, Dunrobin Castle, Golspie.
1882. Sinclair, Peter, Wood Merchant, Perth.
1889. Sinfield, George, Assistant Forester, Witch Wood Lodge, Staple Fitzpaine, Taunton.
1869. Sinton, James, Forester, Stourhead Estate, Stourton, Bath.
1868. Slater, Andrew, Overseer, Haystoun, Peebles.
1873. Smith, G. B., Wire Fence Manufacturer, 61 West Regent St., Glasgow.
1871. Smith, James, The Gardens, Mentmore, Leighton-Buzzard, Bucks.
1883. Smith, James, The Gardens, Hopetoun, South Queensferry.
1886. Smith, John, Surveyor, Romsey, Hampshire.
1870. Smith, Thomas, Nurseryman, Stranraer.
1883. Smith, William, Chemist, Stockbridge, Edinburgh.
1885. Spiers, David, Overseer, Mugdrum, Newburgh, Fife.
1870. Stewart, John, Overseer, Abington, Lanarkshire.
1882. Stewart, John, 13 Burrell Square, Crieff.
1875. Stewart, J. M., Cherry Tree Cottage, Nusworth, Whitefield, near Manchester.
1876. Stewart, Robert, Forester, Stonefield, Tarbert, Lochfyne, N.B.
1876. Stirling, John, Forester, Largie Castle, Tayinloan, Kintyre.
1889. Storie, Robert, 92 High Street, Dalkeith.
1876. Stuart, Charles, Forester, Glenmoriston, Inverness.
1872. Swan, R. G., Auctioneer, Duns.

1869. Tait, David, Overseer, Owston Park, Doncaster, Yorkshire.
1887. Taylor, Andrew, 11 Lutton Place, Edinburgh.
1882. Taylor, William, Assistant Forester, Dupplin Castle, Perthshire.
1889. Taylor, William Fletcher, Knowefield Nurseries, Carlisle.
1891. Tennant, Edward, 195 W. George Street, Glasgow.
1869. Thomson, Lockhart, S.S.C., 114 George Street, Edinburgh.
1871. Tomlinson, Wilson, Forester, Clumber Park, Worksop, Notts.

1883. Underwood, Henry E., Sub-Agent, Fornham, St Genevieve, Bury St Edmunds, Suffolk.

1888. Vincent, Frederick D'A., 8 Ebury Street, London.

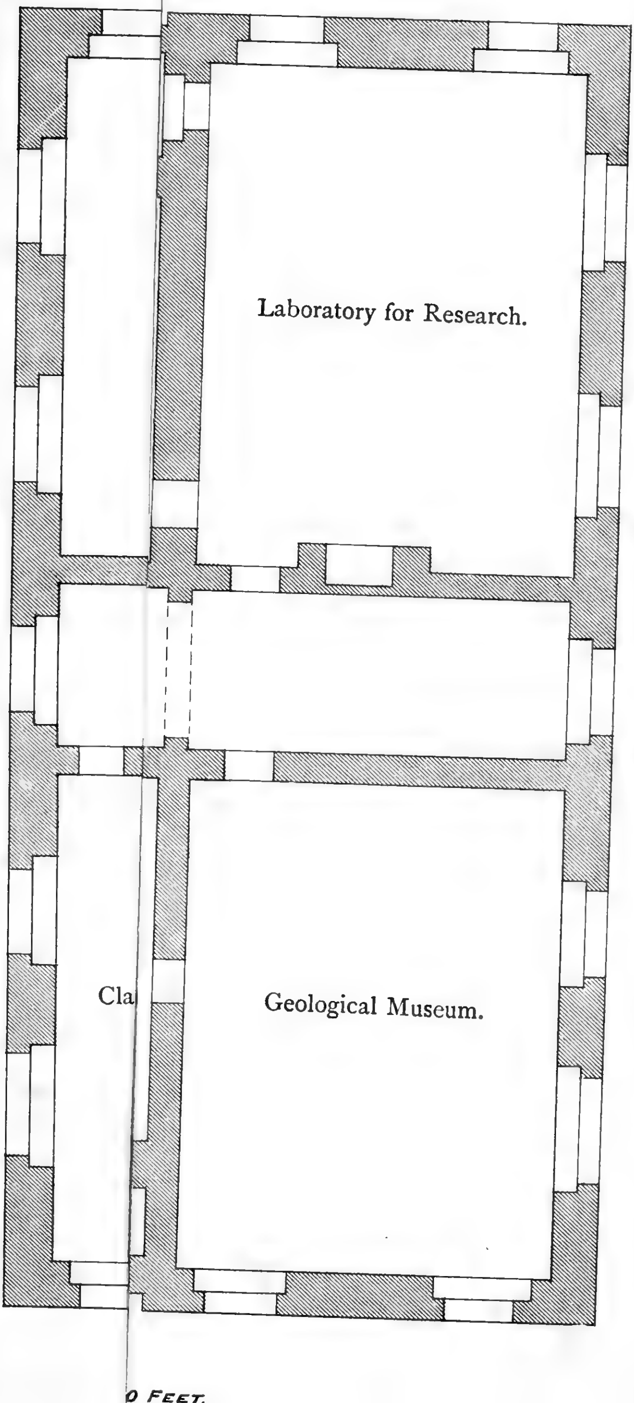
1870. Wall, G. Young, Land Agent, Grange House, Darlington.
1879. Watson, John, of Earnock, Hamilton.
1872. Watt, James, J.P., of Little & Ballantyne, Nurserymen, Carlisle.
1889. Watters, Dennis, Forester, Wester Elchies, Carron, Strathspey.

Date of Election.

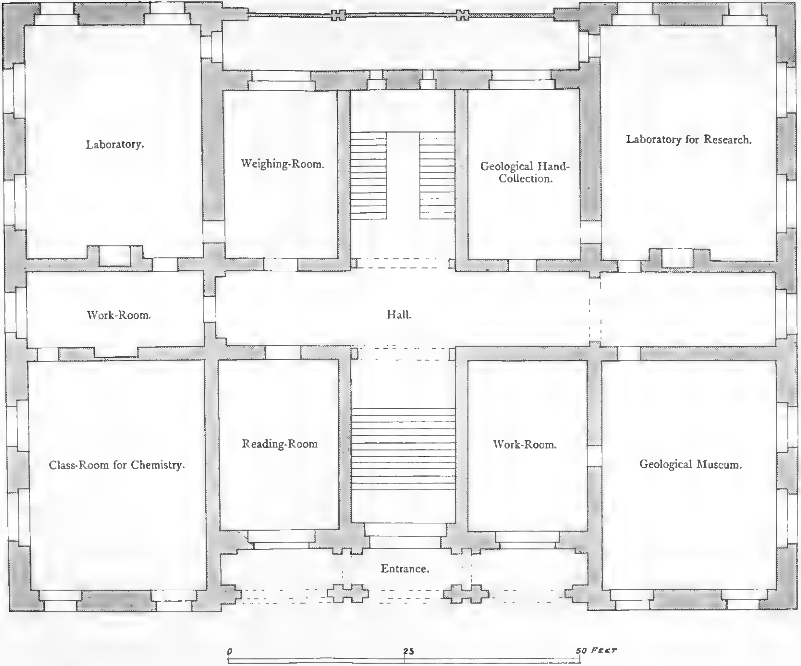
1887. Waugh, Thomas, R.H.S. Gardens, Cheswick, London.
1874. Webster, Angus D., Overseer, Holwood Park, Kent.
1891. Welsh, James, of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1866. Welsh, William M., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1891. Whittingham, William, Estate Office, Norton Priory, near Runcorn, Cheshire.
1883. Whitton, Peter, The Gardens, Methven Castle, Perth.
1884. Whitton, James, The Gardens, Glamis Castle, Glamis.
1883. Wilkie, Charles, Assistant Forester, Lennoxlove, Haddington.
1891. Wilkie, G., Architect, Hayfield, Peebles.
1875. Wilkie, Thos., 21 Belleville Road, Wandsworth, London.
1882. Williamson, A., Wood Manager, Eridge Castle, Tunbridge Wells, Kent.
1889. Williamson, A. T., 7 Kew Terrace, Edinburgh.
1890. Williamson, George, The Links, Leven, Fife.
1887. Wilson, George, Forester, Penrice Castle, Swansea, Wales.
1872. *Wilson, John, Forester, Sudbourne Hall, Wickham Market, Suffolk.*
1883. Winning, John G., Estate Office, Branxholm, Hawick.
1868. Wyllie, George, Ballogie, Aboyne, Aberdeenshire.

1875. Young, William, Forester, Morriston Cottage, Earlston, Berwickshire.
1890. Younie, George, Assistant Forester, Woburn, Beds.

SWALDE.



GROUND PLAN OF THE FOREST ACADEMY, EBERSWALDE.



TRANSACTIONS

OF THE

ROYAL
SCOTTISH ARBORICULTURAL SOCIETY.

VOL. XIII.—PART III.

SECRETARY AND TREASURER,
WILLIAM J. MOFFAT,
FELLOW OF THE BOTANICAL SOCIETY, EDINBURGH.

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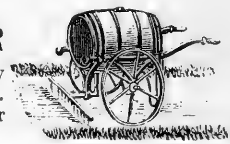

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TRANSACTIONS.

CONTENTS.

The Society, as a body, is not to be considered responsible for any statements or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XX. *Address delivered at the Thirty-ninth Annual Meeting, 9th August* 1892. By ISAAC BAYLEY BALFOUR, Sc.D., M.D., F.R.S., Queen's Botanist in Scotland, Professor of Botany in the University of Edinburgh, and Keeper of the Royal Botanic Garden.

MY first duty is to thank you for the honour you have done me in electing me again to preside over your meetings. The position in which you place me is one of which any scientific man might be proud, and if I do indulge such feelings, they are not unmixed with thoughts of the inadequacy of my service and of the forbearance with which you have been pleased to regard my deficiencies. In response to your request that I should during the coming year act as your President, I can only reply by assuring you that I shall continue to promote, as far as lies within my power, the interest of forestry, and the progress of this Society.

In addressing to you this evening a few remarks, I must, at the outset, congratulate the Society on its prosperity. The secretary informs me that this is quite a record year for the Society in the matter of new blood; no less than fifty-five new members having been enrolled. Surely we have evidence in this of the spread of interest in the subject of forestry throughout the country, and that the efforts made by our Society are continuing to operate with increasing effect in stimulating attention to the importance of our woodlands, alike from an utilitarian and from an æsthetic point of view. And if our accession of strength has been so great, it is pleasant to have to state that losses to the Society and the cause we are all engaged in carrying on, by the death of members, are not an average, and that no forester of outstanding ability has during the past year disappeared from our midst.

In the remarks which I had the honour to address to the Society, from this chair, on the occasion of our last annual meeting, I briefly reviewed the position of the Society with reference to, and the progress it had made towards the attainment of aims for the promotion of scientific forestry after which it had been so long striving, and I ventured to express the hope that before another anniversary arrived the Society would be able to look back on its past endeavours with that feeling of satisfaction, which well-spent effort begets in the successful. It is most pleasing to me to find myself able to say that the past twelve months have been fruitful of solid achievement in the cause of forestry in Scotland; and the fruition, if it has not matured so rapidly as we had looked for, and if it is not so perfect as we could picture, is yet of a kind that we may, I think, be well content to have obtained, and I venture to hope we may claim to have succeeded in laying a foundation of the scientific education of foresters in this country.

It was of forestry education that I spoke in a special manner at our annual meeting last year, and to-night I shall devote the short time I ask you to allow me to occupy to the same subject, in order that I may point out what has been done during the interval in the way of furthering this vital matter.

You may recollect that I laid stress on the necessity of distinguishing the education of those attending our University from that of practical foresters, and I will to-night refer to those two sides of the question of education separately, for I do not require to remind the Society that it has interested itself alike in both.

University Forestry Education.—We met last year with a feeling of misfortune, in that we had lost the services of Dr Somerville, who had done such yeoman service for our cause in Edinburgh; and it seemed, for some time after his migration to Newcastle, that the difficulty of filling his official post amongst us as University Lecturer on Forestry, which we all knew would be so great, was to be even greater than we had supposed. But Lieutenant-Colonel Bailey, R.E., whose name is well known to all who are familiar with the aspects of Indian forestry, an officer of wide experience, and whose personal qualities are no less admirable than his interest in forestry, stepped at short notice into the vacant lectureship and continued the work, which Dr Somerville's departure threatened to interrupt. It will, I am sure, be the sanguine hope of every member of the Society, that, under Lieutenant-Colonel Bailey, the progress of University teaching will proceed as rapidly and as effectually as it did under Dr Somerville, and the Society will extend a most hearty and sympathetic welcome to him.

To the work conducted by Lieutenant-Colonel Bailey the Board of Agriculture continued the support given previously to Dr Somerville, and until sufficient endowment is obtained for the creation of a permanent Professorship of Forestry in the University, it is to be hoped the Board of Agriculture will not refuse to grant the £100 per annum by which so much has been already done.

And this brings me to the question of the Endowment Fund for a Chair of Forestry in the University, to the raising of which the Society has devoted attention. As you are aware, the Highland and Agricultural Society has interested itself in this matter, and, like this Society, has obtained some money towards the fund. The amount already promised and in hand from all sources is, I understand, about a quarter of the total sum required, if the endowment is to be such as to place the Forestry Chair on a footing equal to that of other endowed chairs in the University of like character. The secretary will, at a later period, give us details of the figures. This is not altogether so satisfactory a result as we would wish for, but I see no element therein of discouragement. What I would say, and I believe you will all join me in saying it, is, we must get the money to endow the chair. For this purpose our efforts must be redoubled, and we must, in every possible way, endeavour to bring before those to whom good forestry is a matter of solid importance, the claims which forestry teaching in the University has upon them. A joint circular has been drawn up by the two Societies, this one and the Highland and Agricultural Society, and is to be issued at once. Let me, on behalf of this Society, ask our members to use every diligence in bringing it before those who should be willing and are able to subscribe to the fund.

There is one other point bearing on university education in forestry which demands notice from me here. It is the position of forestry side by side of others as one of education in the University. Members may remember that the Society addressed a communication to the Universities Commissioners on the subject of forestry teaching, and amongst the points urged upon their attention was the inclusion of forestry amongst subjects qualifying for a science degree. In a certain measure this has been favourably considered by the commissioners. In the draft ordinance for degrees in science in agriculture, the commissioners have placed forestry as one of the subjects of study in the curriculum, optional, however, with two other subjects, engineering and experimental physics. But this is not enough. What we want, and must have, is that it shall be compulsory, and I am not without hope that representations may be successful in securing the assignment to forestry of an essential place in the curriculum, a place which I do not think can be rightly denied to it. However this may be, there is ground for our expression of satisfaction, that the claims of our subject have been so far recognised by the Universities Commissioners. If their full recognition is not to be yet, time and organisation of the teaching of the subject will certainly bring it about.

You will gather, then, that we have made some advance during the past year in pressing towards the development of university teaching of forestry in Edinburgh. We have not yet surmounted all the obstacles that stand between us and the realisation of our ideal; let us put even more energy into our endeavours and carry them to full success.

I turn now to the *Teaching of Practical Foresters.* With regard to this the only point for dissatisfaction is the delay that has taken place in establishing the scheme which I unfolded in the remarks I made to the Society last year. By a notice in the *Scotsman* a few days ago, all of you will have learned that the scheme has been sanctioned, and the money required under it is now at our disposal. We may, I think, fairly exult over this achievement. We have now the means, in response to prolonged efforts, of providing for the education of foresters in the science underlying their profession. The day of carrying out the education of practical foresters has come, and as in the past we have shoulder to shoulder fought our battle for means of education, and have succeeded, so now we must in like manner co-operate to make the working of the scheme of education a practical success.

You know the essence of the scheme. Whilst educating foresters in the necessary sciences, work will be found for them in the Botanic Garden, and I hope elsewhere about Edinburgh. You may ask then what is to be our next step towards making this teaching a reality? We are all agreed, I take it, as to what we propose to do, to educate foresters in the sciences underlying their profession, and we have then two important points now to determine,—(1) When is the teaching to begin, and how is it to be conducted? and (2) under what regulations are foresters to be admitted to the instruction?

I am glad of this opportunity to say something upon these heads, in order that through this Society young foresters throughout the country may become acquainted with our proposals:—

As to the date of beginning and the method of the course: I think October will be a convenient month in which to open the course of instruction. The present and next month are emphatically holiday months, and I should hope that by October it would be possible to arrange all preliminary matters. I have already been able to arrange for the teaching of several of the subjects proposed for the curriculum, and having secured as lecturers in several instances the assistants to the professors in the University, I am assured that the teaching will be of a most satisfactory kind. It will of course be our endeavour to make the instruction of as practical a character as possible, and the times of lecture and work will be so arranged that they will not interfere with the usual hours of labour.

With regard to the second point:—Whatever rules are framed, they must be of a kind that will admit the right men, and will exclude the men who will not profit by the course. But it is not easy at the initiation of a scheme such as this to lay down definite rules, inasmuch as we have no means of estimating to what extent the opportunity we offer will, in the first instance, be taken advantage of, and it is evident that the number of men who can be taken on the staff of the Garden must be limited. But this is just one of these matters in which I look, and I am sure with justification, to the co-operation of members of the Society. This Society having given its imprimatur to the scheme, and nurserymen of Edinburgh having signified their willingness to aid in carrying it into effect, I have no doubt that a large number of competent men, should they desire to pass through the curriculum proposed, will be able to find employment in Edinburgh enabling them to do so.

There is one condition I would mention that I believe will commend itself to you as of necessity attaching to the scheme. We must insist on all men coming to the course being practical men, who have had some years' experience. The course is designed for them, and you will agree with me in thinking that men who have not had some such experience could not profit by the teaching we propose to give to the extent that those who have had such experience would do, and this condition is an essential one. And then whilst we are, so to speak, in the dark as to the amount of interest the course will arouse, yet we all believe it will attract considerable attention, and be appreciated amongst practical foresters, and therefore we must be prepared to institute some sort of means of selection amongst those who may apply for admission to the course, should we find from the number of applicants or other cause that it is necessary to do so. Beyond this I do not see that we need go at the present in the making of regulations.

How are we now to make known to those who are likely to desire to attend our course the education we offer? I think the simplest plan that could be adopted would be this,—and I propose to adopt it,—to draw up a circular, which would be submitted to members of the Society able and willing to advise upon it, embodying a sketch of the course of instruction, the method in which it is to be carried out, and the regulations under which men may be admitted to it, along with a schedule to be filled up by an applicant, which would be returnable, say, by the middle of September. This circular and schedule, when adjusted, would be issued to proprietors, foresters, and others in the country who are interested in the subject and whom we could reach.

Upon all these points concerning the scheme I should be glad to have an expression of opinion, with suggestions from any member of the Society who will be so good as to favour me with them. During the excursion of the Society, which I hope to join, there will be opportunity of informal conversation upon the questions involved, and I shall be happy to discuss them with any members who may be willing to do so.

In the way I have indicated, gentlemen, I hope that before many weeks are passed the scheme we have devised for the teaching of practical foresters may be fairly launched. Personally, I shall do my best to make the scheme a success, and I believe it has in it the germs of success, in which belief I am fortified by the approval with which it has been received by the Society. But it is well that we should bear in mind that this is only the beginning of that portion of our ideal forestry school providing for practical foresters. We must not expect to be able to create all at once a perfect school for the teaching of our science. Like the tree itself, such a school, to be sound and durable, must grow slowly. But I would venture to hope that this beginning we shall shortly make is the foundation of a permanent school by which all the aspirations of foresters, so long expressed by this their representative Society, may be attained; for, however it may be in other spheres of work, I think we may, looking at our progress within the recent past, regard the flowing tide as being with us, on which I trust we may be carried to the full accomplishment of the aims we have set before us.

POSTSCRIPT.—The circular alluded to above was issued in the form subjoined. It was found advisable to postpone the opening of the Course of Lectures until after Martinmas term day.

Course of Instruction for Practical Foresters and Gardeners at the Royal Botanic Garden, Edinburgh.

CIRCULAR.

By arrangement between the Commissioners of Her Majesty's Works and the Board of Agriculture, a course of study in the Sciences underlying the Practice and in the Principles of Forestry and Horticulture will be instituted in the month of October of this year, at the Royal Botanic Garden, Edinburgh, for Practical Foresters and Gardeners.

The curriculum will extend over two-and-a-half years, and will include the following subjects:—Chemistry, Physics, Meteorology, Geology, Surveying, and Mensuration, Entomology, Botany, Forestry, and Horticulture, and these will be taught practically as far as is possible.

The curriculum will be free of charge to those who are admitted to it.

The times of the classes will be arranged so as not to interfere with the usual hours of labour.

No one will be admitted who has not had at least three years of practical experience in forestry or gardening.

Applicants for admission must submit a recommendation and certificate of character from their employer.[1]

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[1] If an applicant happens to be out of a situation, a recommendation and certificate of character from his last employer should be submitted.

A certain number of men will be employed as members of the working staff of the Royal Botanic Garden, Edinburgh, during the period of the curriculum. Such men will serve under all the regulations in force in the Garden, and will receive the current wages of their grade. Through the co-operation of the nurserymen in Edinburgh, arrangements will be made for the employment of others in the nurseries about Edinburgh during the period of the curriculum.

Those who are admitted to the curriculum will be examined from time to time upon the subjects of study, and any one who does not show satisfactory progress may be debarred from continuing the curriculum.

Practical foresters and gardeners desirous of entering on the curriculum are requested to fill up the form on the other side, and to return it not later than the 5th October, along with the recommendation and certificate of character mentioned above, addressed to the Keeper, Royal Botanic Garden, Edinburgh.

Should it appear to be necessary or advisable, some method of selection amongst the applicants may be adopted.

Applicants will be duly informed whether or no they have been admitted to the curriculum.

Isaac Bayley Balfour,
Keeper of the Royal Botanic Garden, Edinburgh.

15*th September* 1892.

Schedule.

Form to be filled up by Applicants for admission to the Course of Instruction for Practical Foresters and Gardeners at the Royal Botanic Garden, Edinburgh.

Name
Address
Date of Birth
Birthplace
Forester or Gardener
Name and address of present employer
Length of time in present situation
Previous situations and length of time in each
Do you desire employment in the Royal Botanic Garden, or in a Nursery at Edinburgh, during the period of curriculum?

Royal Botanic Garden,
Edinburgh, 15*th September* 1892.

Sir,—I have the honour to send the annexed prospectus (with form of application) of a Course of Instruction for Practical Foresters and Gardeners about to be instituted in this establishment, and to ask for your co-operation in making known the course to suitable men. I shall be glad to send additional application forms should you require them.

I would specially invite your attention to that feature of the scheme by which it is proposed to find employment in and about Edinburgh for young men from a distance desirous of taking advantage of the instruction offered, and in this way to enable them to support themselves during the period of study. The wage obtainable would be 17s. per week in this establishment, and about 2s. 6d. per day in nurseries.

The advantages of the opportunities of study afforded by the scheme are so evident that they will probably be sufficient to induce good men to accept employment in Edinburgh at the rates mentioned, even although some diminution in their earnings is thereby involved. There is, however, the possibility that a deserving man might be called upon to make a pecuniary sacrifice in taking such employment which circumstances would not allow him to contemplate, and he might thus be precluded from attending the course.

To meet such cases, and to supplement the wage obtainable, it has been suggested that the County Councils and other bodies having control of the administration of funds which could be allocated to such a purpose might, in different localities, see their way to making small grants, in the form of bursaries, to aid men desirous of working through the curriculum, and that many individual proprietors would be glad to give some additional pecuniary help to young men from their neighbourhood who wished to reap the benefit of the education offered.

I therefore take the opportunity, whilst bringing under your notice the course of instruction proposed, to ask for your consideration of the suggestions I have mentioned, and to solicit your aid to give practical effect to them.—I have the honour to be, Sir, your obedient servant,

ISAAC BAYLEY BALFOUR.

XXI. *On the Preparation of Wood Specimens for Exhibition.* By George Cadell, Langley House, Surbiton, Surrey.

Introduction.

Some little time since I was asked by the manager of the Kimberley and South African Exhibition, which is to be held in 1892-93, to draw up for the information of his executive committee some suggestions for the effective display of their woods, with the view of their being sent on afterwards to the World's Fair at Chicago. The idea of writing a short paper on the subject has thence emanated. While I am aware that it is somewhat of a rash adventure to put forward any suggestions, or, *à fortiori*, to lay down any rules which may come under the notice of members of the Royal Scottish Arboricultural Society, who knew so well how to set off their exhibits to the best advantage, and to arrange them with the best taste, in 1884, yet I trust this rashness may be viewed with indulgence. For I may be permitted to remind them that neither in the pages of their own *Transactions*, nor in *The Timber Trades' Journal*, the organ of the British timber trade, is there, so far at least as I am aware, any code of directions laid down for those who are tyros in the art. The very temerity of my attempt, therefore, will find its best excuse in the evoking—if happily it may evoke criticism and correction, and in the framing by some competent authority—of whom the Society possesses within its ranks some well-known names—of rules and regulations for general guidance and adoption. For in these days when imperialism is so constantly brought under our notice, when its demands and aspirations have been focussed under one great centre, the Imperial Institute, we want to know, and we shall expect it to teach us, what are the real resources of the empire, and whence any deficiencies known to exist within the bounds of our own islands may be satisfactorily and quickly supplied.

I cannot think that, so far as woods are concerned, this information has been fairly, much less exhaustively, pushed. New woods have certainly been taken into favour, notably the padouk wood—*Pterocarpus indicus*—of the Andaman Islands, regarding which I read in the last annual circular of a well-known firm of timber importers as under:—

"*Padouk.*—The supplies have been 1·446 loads, and a good business has been done. The use of this wood is steadily extending. Values range from 3s. to 3s. 9d. per cubic foot."

I fear, however, that this is the exception rather than the general rule, and that this wood owes the particular estimation in which it is held to the fact that the supplies of mahogany—a wood with which it more directly enters into competition—from Honduras, Mexico, and Cuba have been somewhat short recently. It is important, however, to notice this, because it is with special view to competition, and, wherever practicable, the substitution of British, that is Indian and Colonial, woods for those of foreign growth, that this necessity for uniformity in display is becoming more urgent. Even as I write the supply of English ash is scanty, and any really satisfactory substitute for it could at once command a market and a value.

Now the exhibition of woods and timber specimens of all sorts has before it two main objects—*first,* their interest for scientists; *second,* their economic value.

In the preparation of the specimens, therefore, these two objects should never be lost sight of; and in attempting to attain and illustrate them I would give the first place to

The Preparation of Forest Plans and Charts.

I have elsewhere insisted upon the great usefulness of maps and plans, especially when the woods of a country which has different and sometimes sharply-defined zones, and correspondingly distinctive flora, are to be exhibited. To those who witnessed the display made by the Japanese Government at Edinburgh, or by the Government of Norway at Amsterdam, this insistence on my part may appear gratuitous. And I am aware that the Government of India, as well as our foreign neighbours, have nothing to learn regarding the usefulness of maps. Of the former, indeed, an intelligent French critic has thus written in reviewing the list of their exhibits:—

"*Literature and General Cartography.*—In my opinion this is the group which enables us to form the best judgment of the degree of perfection to which the technical value of personal administration has arrived. The Indian Forest Department has nothing to fear from the results of such criticism."

My insistence, therefore, is only advanced on the principle that *gutta cavat lapidem non vi sed sæpe cadendo.*[1] And if my

[1] A drop of water hollows out a stone not by force, but by constant dripping.

humble efforts can more generally impress this view, I shall gladly underlie the charge of iteration and reiteration.

To take a country with whose flora we are all more or less familiar, and which well illustrates my meaning, I append a rough Forest Chart of Switzerland. Here we have certain trees occupying with tolerable exclusiveness well-defined regions of the same country, while that country itself divides the distinctive flora of Northern Europe from the distinctive flora of Southern Europe. Such a map, of course more accurately prepared, should accompany every exhibition of wood specimens, explanatory tables being appended to show the number of trees of each sort, mature and maturing, which are or will become available in given years. We have further at a glance the position of the woods with reference to their accessibility, and the means available, whether by road or by water, for the transport of their products to an inland or sea-coast market. I should like to see such maps illustrating all the portions of the British empire, and I may perhaps be permitted to add that I should like to see such a map in an early volume of the Society's *Transactions*, which would do this good office for Scotland, which, so far as forestry is concerned, is *facile princeps* amongst its own immediate neighbours.

Preparation of Wood Specimens.

In regard to the size and shape of the wood specimens, of course tastes are various, *quot homines, tot sententiæ.* We have little bricks of wood carefully polished, and we have the rough unhewn product of the virgin jungle. Both have their values, and both have certainly their disadvantages, the latter to my mind preponderating. Looking to the objects I have noted above as applying generally, I would venture to limit the preparation of actual specimens to two classes with regard to their ultimate destinations, *i.e.*, the museum of the botanist, or the timber-yard of the importer. Neither of these should, I think, be small.

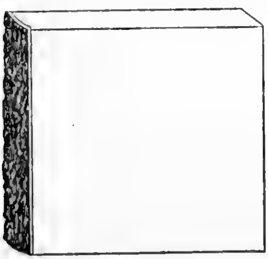


Fig. 1.

For scientific purposes I might admit, in deference to the opinion of others, those specimens made in book form (Fig. 1). Here the size should be not less than 12 inches by 12 by 3 inches, the bark of the tree being left on the back, and one side of the specimen should be polished and the other plain.

But for ordinary purposes I prefer something larger, even in spite of its comparative unhandiness. The segments which I have in my mind, but which I regret I can only imperfectly delineate, are as shown in Fig. 2.

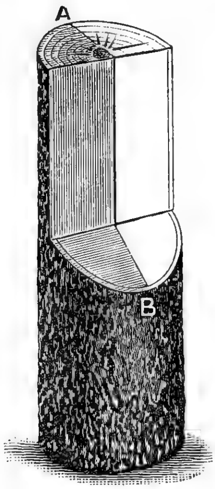


Fig. 2.

Here the specimens are primarily logs or trunks of trees with the bark on, not less than 3 feet in length, and cut first across, second transversely, and third at an oblique angle sloping from the core outwards to the bark. The grain of the wood is thus exposed as subjected to these several cuts; the proportion of sap-wood to heartwood is clearly apparent—that in some woods, for example, the Indian ebony, *Diospyros melanoxylon*, being very remarkable; and the colour of the outer and inner wood is in strong contrast. The bark is, except where the wood is exposed by the above cuts, carefully preserved, while the wood itself is on one side of the line from A to B polished, the other side being left in its natural condition. This form of specimen has the further advantage of evidencing the annual growth of the tree, a subject to which I shall come later on—the concentric rings, the medullary rays, and generally the botanical structure.

For the test purposes of the importer the logs or beams can hardly be too large. The most reliable results will be given, *ceteris* *paribus*, by the largest logs, and the weight, for instance, of the cubic foot will, in some woods at any rate, be very much larger in the case of the log than in that of scantlings. The following results, for example, were obtained from beams of the Indian teak tree, *Tectona grandis*, which were 10 feet long by 4 inches by 6 inches.

Weight per cubic foot, 45 to 50 lbs.
Value of P = 600.
Modulus of elasticity = 5000.[1]

To illustrate what I have above said regarding the power results obtained from scantlings, I may mention that in the professional papers published at Roorkee, the actual weight of the teak in log was given at 50 lbs. per cubic foot, and in scantlings at only 35 lbs.—the latter having probably lost the essential oil which would be retained in the former.

Illustration of Rate of Growth.

I am now brought to a consideration of the use of specimens in ascertaining the rate of growth, which is not the least interesting and instructive of their uses. For this purpose the kind of specimens I have commended, varying of course in size according to age, seems to lend itself most naturally to this part of my subject. Here again, however, we shall require explanatory tables. For we want to know the kind of soil in which the various specimens have been reared—the height above the sea-level of the forests or plantations whence they have been taken—the increment of annual growth, in fact everything that can tell us anything of the history and nature of the tree which is represented by its section. This is especially useful to the planter, whether represented by an individual or by a government, who wishes to raise trees, not merely for ornament and use, but for pecuniary profit. I would make special reference in this regard to the specimens of oak shown by Sir James Campbell in 1884 as the products of the

[1] P is the result of formula $\frac{W \times L}{B \times D^2}$.

W is the weight which causes the beam to break.
L = length of beam in feet between the supports.
B = breadth of beam in inches.
D = thickness of beam in inches.
P being generally adopted to express the power of the beam to resist superimposed pressure.

Forest of Dean, varying in age from thirty to two hundred and twenty-eight years, and to the thirty-three specimens of teak sent from the Government plantation at Nilambúr, South India. For these form, for foresters, exhibits second in interest to none. I do not want to intrude upon other men's preserves, but the official reports of the Nilambúr teak plantation are common property, and from them, not to be too diffuse, I extract the kernel for the information of my readers, as under:—

I. Trees of seven years of age grown
   (*a*) On alluvial soil showed a total height of 29 feet, and a girth at breast high of 12 inches.
   (*b*) On gneiss and laterite showed a total height of 30 feet, and a mean girth of 13 inches.

II. Trees of thirty years of age grown
   (*a*) On alluvial soil showed a total height of 85 feet, and a girth at breast high of 35 inches.
   (*b*) On gneiss and laterite showed a total height of 50 feet, and a girth of 24 inches.

Here it is interesting to notice how rapidly after the seventh year the trees planted in alluvial soil outstripped their companions which had tapped a less congenial substrata. And it conveys a lesson to us all, that while trees will certainly grow almost anywhere, they can only be grown to profit and advantage where the subsoil is suited to their respective requirements.

At the risk of being tedious, but for a direct reason which will be apparent a little further on, I append a few more figures regarding the rate of growth of teak in the same plantation.

The periodical annual increment of growth in trees of nine years of age was found to be 1·1 cubic feet, in trees of nineteen years 1·3 cubic feet, and in trees from nineteen to twenty-nine years 2·8 cubic feet, showing the rapid ratio of annual growth which took place after they had attained the age of nineteen years.

Nomenclature.

I come now to a subject which may be thought unnecessary. It seems a childish matter to insist upon giving the specimens a name, for the infant does that to its playthings or to the live pets which surround it. And yet the most extraordinary, and, I may add, the most fatal mistakes have arisen from incorrect nomenclature, and the consequent impossibility of identification. I knew of a case where a wood was highly appreciated for the natural oil it possessed, which enabled articles made from it successfully to resist intense friction. A large consignment of this valuable wood was ordered and found to be absolutely worthless, being in fact another wood altogether. The samples of wood exhibited should bear not only the vernacular or local, and the botanical name, but also the name by which it is known to commerce. If it is not already known in the commercial world, then the name of the wood which it most resembles should be given. And in this branch of nomenclature, to give a wood a bad name is to spoil its chance of acceptance. I do not think, for example, that the market would jump at the "stinkwood" of Africa, although the tree, *Oreodaphne bullata*, which produces it is an excellent timber tree, and the wood is extremely useful for railway sleepers and the like. Any new wood should be launched under a good name, and if the stinkwood were rechristened the African oak, a name which it could rightfully adopt, its chance of success would at once be doubled. I have not thought it well to insist upon the fact of the wood bearing the true botanical name of the tree from which it is cut. For this goes without saying, and it would be better to leave the name out, or to place it thus,—species?—than to give it a false name which could only be misleading.

Fibres, Dyes, Gums, Resins, etc.

Lastly, I come to what are called the minor forest products. It is part of the object of an exhibition to show *all* the resources of the subject which it illustrates. There are many trees, such as the *Canarium strictum*, *Pterocarpus marsupium*, and a host of others, of which the gums they exude form not the least important part of their products. It cannot be said that the knowledge of these is by any means exhaustive. The importer would hail with delight any real substitute for gutta percha. However, a mere list of the fibres already known to commerce, and in a greater degree a list of those which have failed on trial to commend themselves, would in itself gratify neither my readers nor myself. These have formed pegs on which to hang the introduction of carding and cleaning machines innumerable, and the recollection of their worthlessness cannot but be painful to many who have embarked money in the attempt to establish them.

Conclusion.

I have given my readers figures for a reason which they may not, I trust, consider presumptuous. The forester, and, I may add, the Scottish forester, is his own best teacher, and they may like to make experiments to determine the data I have above given in the case of the trees growing in their own woods. For this purpose, and to bring the matter nearer home to them, I give below very briefly some data regarding the *Pinus latifolia*, one of the five Indians pecies of Coniferæ, in order that they may compare them with results they themselves may obtain from their own *Pinus sylvestris*. Weight per cubic foot, 27 lbs. Value of P or transverse strength, 906-961.[1] I would also venture to commend to their attention the yield tables for the Scots pine, calculated from the detailed measurements of 351 Scots pine woods, situated in Alsace, Baden, Bavaria, Prussia, and Saxony, and converted into English measure by Dr Schlick, C.I.E., Ph.D. These would be extremely interesting for the purposes of comparison with the results obtained in their own woods; and, with a small collection of wood specimens, each forester might have for himself a museum not less instructive, so far as it goes, than the Imperial Institute, which will count its treasures by thousands.

Note.—We were told that in 1881 the number of wood specimens named, numbered, and described for India alone were 2530, belonging to 906 species and 432 genera, and the number since identified has doubtless largely increased the tale.

[1] See *ante*, note to page 314.

XXII. *The Afforestation of Large Areas in the Highlands and Islands of Scotland.* By W. A. Mackenzie, Strabane, Brodick, Isle of Arran.

The fact of raw material being the basis upon which the wealth and prosperity of a fully peopled country depends, it behoves the rulers and leaders of the nation to put forth every possible effort to keep up the supply, in order that the workmen shall be fully employed, and thus prevent the draining of money from their own country to that of others. In no country is this precaution more necessary than in our own, because, notwithstanding the opportunities we have for producing a large proportion of such timber as we buy in other countries, we, as a nation, take no advantage of these opportunities. The whole matter is left to individual efforts, which, from various causes, are inadequate to make more than a very slight impression on the wants of the country, by supplying marketable timber, or afforesting such portions of our waste lands as are not already so profitably employed. If the people of this country could be brought to see the importance of having the waste lands planted,—the importance not only to themselves, but to future generations,—they would make it a point of first-rate political consequence. Those who quite understand the question, and the value such a movement would be to the country, think it worthy of the consideration of statesmen of the first rank; and it certainly deserves to be laid before the people by their representatives, and made a parliamentary feature at a general election. Out of about ten millions of acres, more or less suitable for the profitable growth of timber, under a million acres are so employed, leaving for such a purpose at the disposal of Parliament, failing private enterprise, an area of about nine millions of acres. At the age of say seventy years, the timber on such an area would be worth to the country a clear sum of about £240,000,000, after paying for planting, fencing, maintenance, and interest at three per cent. on capital for thirty years, because after that age such woods, if judiciously managed, would pay all costs. But this is not all. Had it been so, it could not be supposed that the general public would evince much concern with a project which would take from fifty to seventy years to complete. But the general community would, in a few years, receive a very direct benefit in the form of a more uniform and genial climate, while the benefit commercially to the adjoining lands would double the interest paid on cost of planting. These points are well known to most arboriculturists, and need not receive further attention here. At present, the great difficulty seems to be the want of money to carry on the work by private enterprise. But if encouraged by Government offering a subsidy of a certain sum for every acre planted in large areas, landowners would, no doubt, take advantage of such encouragement. And why should not Government encourage this industry by subsidy? just as they do steam shipping companies for carrying the mails to foreign countries, and many other schemes of national benefit.

Another way to accomplish the end in view would be for Government to lease, under Act of Parliament, such lands as are not profitably occupied, leaving it in the option of the proprietor to redeem at any future period during the lease, the subjects so acquired, either at a valuation, or on paying the costs and interest up to the date of redemption. This could be carried out under the supervision of what is known as the Enclosure Commissioners, together or in connection with a School of Forestry. The work of supervision could be done by the commissioners at no additional cost to the country, and some of the practical details could be worked by, and under, the directions of the managers of the School of Forestry.

A third way to effect the same purpose would be by the Government taking over all waste lands and planting them, reserving to the proprietor and his successors, power to resume the lands, together with the crops, buildings, fences, etc., on paying all the costs, and such interest as would be stipulated for in the parliamentary enactment giving such powers; or by paying to Government such a sum per annum, for a given time, as would cover capital and interest; taking care that the land could not be alienated from the present landlord and his successors, without his express consent, and that of his heirs, as is now required under the Acts of Entail.

These are the brief outlines of several methods by which the Highlands and islands of Scotland could be clothed with growing timber within a reasonable time.

Preparation of the Land.—The first operation is that of enclosing. This may be done in various ways—by wire on wood or iron posts, by walls built of such stones as may be found on the land, or by turf fences. The latter method has the advantage of sheltering the outer edge of the plantation for some years after planting, and provides a nice seed-bed for broom and whin, which may be sown on the "backing" of the mound. The cost of this method varies with the situation, but on the average it would be about 9d. per running yard. Owing to the liability of the ditches to get cut up by floods, these fences should only be employed on tolerably flat ground, or along the base or top of plantations, if such is practicable. This kind of fencing is so valuable as a shelter, that it would pay to cut catch drains at short intervals to run off the water.

Next to the turf fencing in usefulness is a stone-faced dyke, built on the same principle as the turf fence, stones being used for the face throughout, with the exception of the cope, which should be of turf. This fence has also an earth "backing" with a scarcement and ditch, and the cost would be from 7d. to 10d. per lineal yard, according to circumstances.

The third, and most economical method in the end, is that of wire-fencing of various kinds, the most durable being throughout made of galvanised iron. A good fence is made with T iron standards, with two I droppers between each pair of T standards. The standards should be self-fixing, or fixed in a base of Portland cement. For fixing with cement, small pits should be dug at the proper distances apart and filled up with clean broken stones, in which the standards are placed in position. When this is done, very little cement will be required for concreting the mass into a solid block. The fence should consist of five wires, the top one being a barbed wire. The cost of this fence would vary according to the kind of posts or standards employed. On wood posts it would cost about 10d. per yard, and with T iron standards and droppers, all galvanised, about 1s. 3d.

It is impossible to say exactly what system of fencing should be adopted in any particular case, for much depends on the position of the proposed plantation.

Draining.—The draining of waste lands previous to planting is a very simple operation, and comparatively inexpensive when properly carried out. The best system, in the absence of brooks or runlets, is to run a large "leader" along the lowest parts of the ground to be drained, and into this run small lateral drains, at an angle of about 75°, being careful not to have too rapid a run to cause "gutting" in floods. What are known as "well eyes" (*i.e.*, where the perennial discharge of water takes place on hill-sides) should always be "tapped" by a drain, and thus avoid the cost of draining the whole "bog" formed by the spring. Land requiring to be drained can easily be detected by its wet, spongy appearance, and the vegetation with which it is covered. It is often found difficult to drain shallow basins having moorland "pan" underneath. The best and cheapest way to do this is by the use of explosives, such as tonite, which is a cheap and safe explosive. Begin the operation by driving a heavy crowbar right through the "pan"—which is usually from a few inches to 2 feet below the surface—at every 10 yards or so, and charge the holes with the explosive. If the "pan" be about 2 feet below the surface, a two-ounce cartridge of tonite will be sufficient to fracture the pan for a few yards around; but for less than 2 feet of depth, an ounce cartridge will be found sufficient. The cost will not exceed 20s. per acre. The advantage of draining the "pan" by this method is that it never again unites, being so thoroughly disintegrated by the concussion that it becomes mixed up with the soil. The writer has seen the effect of this method on land where it was performed sixteen years ago, and it is still quite open and friable, with a fine crop of young timber now growing upon it.

Clearing the Land for Planting.—This operation is often difficult, but cheap and effectual means can be applied to most herbage, dank grass excepted. Heath should be burned in stripes, two or more yards wide, where it is so rank as to overtop ordinary plants of either Scots fir or larch, leaving about a yard between each stripe for shelter. The burning should be from bottom to top of hills, and on level or moderately level land across the path of prevailing winds. The burning is done best in March, during dry weather and moderate winds. Fire the heath in stripes, and give a stripe to two men or lads to keep under control, and to guide the burning in any required direction. The checking of the burning is effected by what is known as "flogging," and for this purpose branches of spruce or Scots fir are used, or better, properly made "mops." These are made of stripes of any old woollen material about a foot in length, tied by means of wire to hazel or ash rods, supple enough to bend, but rigid enough not to turn in the hand. Old sacks do very well. By this means there should be no difficulty in keeping the burning in check. If a few stripes are being burned at the same time, it is better to have a spare man or two to look after any little spark that may be lurking in the heath ready to devour the shelter stripes. The cost of this operation will depend greatly on the force of the wind, and the activity of the persons in charge, but from 1s. to 2s. 6d. per burned acre should cover the total cost.

Another kind of brushwood difficult to deal with is whins and sloes. Probably the most effective way of removing these is by horse-power, and is carried out in the following manner:—A chain is passed round each bush or clump, and is run through an "eye" link in the same manner as is done when dragging logs of wood. Two lads with a tractable horse would be able to clear a considerable portion of land in a week; but much would, of course, depend upon the thickness of the plants upon the ground, and no estimate can be given. Suffice it to say that the plan is found much cheaper and more effectual than grubbing by mattock, not costing one-fourth the price of the latter. Grass, particularly on damp ground, is almost an impossible obstacle to get rid of. The only effectual way to prevent choking is turfing (*i.e.*, paring), but such grassy swards are seldom met with in situations forming the basis of this subject.

Shelter.—In very exposed places this may be afforded in several ways, either artificially or naturally. By artificial I mean raising turf-dykes, or mounds, such as those already mentioned; and by natural is meant shelter obtained by planting hardy trees in such positions as to break the wind. Plant either in narrow belts or in clumps throughout the entire area—elder, plane, mountain pine, and, especially in maritime districts, sea buckthorn; and except near the outside of the plantation, where the shelter must remain, in such a manner as to be removable in the course of the after-management, so as to form roads and shooting drives. Shelter-belts or clumps should be planted several years previous to planting the crop, so that they may have a hold of the ground before the young plants are put in. Artificial shelter by ridges or dykes is liable to serious objection, from the tendency of snow to form deep wreaths to their leeward, and thus large areas of plantation may be crushed down, as is often seen in upland districts. If hardy trees are planted, and whin and broom sown on the ridges, it is surprising what shelter is obtained. Another very good natural shelter is the "wattle" fence placed on exposed positions. These structures are easily and cheaply made by driving a line of stakes on the ridges, or on exposed situations, about a yard apart, taking birch, hazel, or any kind of brushwood, and weaving it roughly between the stakes and leaving it quite open to let the wind pass through, for otherwise the fences would be liable to destruction during gales. This method is only available where plenty of underwood and scrub abound.

The *Selection* of the trees and the *Mode of Planting* are matters for the forester on the spot to deal with effectually, as no hard and fast rule can be laid down to suit all cases. A general rule, however, is to select the plants of a size, age, and species to suit the soil, herbage, and situation. Generally speaking, the smaller the plants are, the cheaper and more successful will be the plantation; and taking the Highlands broadly, two-year seedlings, one year transplanted, are the handiest and most useful plants of most of the pine tribe. So much depends, however, on the exposure and soil, that where to plant, and what to plant, must be left in the hands of the *practical forester*. Volumes of theory could be and are written on this subject, but to no practical effect, even from the pen of the most subtle writer; the practised eye and experienced judgment of the forester are the only reliable medium. Examples—and striking examples—of what the practical forester can do, if left to his own discretion, can be seen in many parts of the country, as in Strathconon near Strathpeffer, and on the Lovat and Ord estates near Beauly.

As has been said above, plants should be of such species as are suitable for the different soils, altitudes, and exposures that are to be found in all extensive areas. While that is so, a general idea may here be given. In planting for profit, it may be laid down as a rule, that even in inland situations, hardwoods, such as the oak, ash, plane, and elm, should not be planted above 800 feet altitude, and only in situations highly suitable. This, however, does not refer to such of these trees as may be used in forming wind-breaks or shelter-bands for plantations of large extent. It will be found that for planting in the Highlands the pine tribe is the most successful, and therefore the most profitable; but it cannot be too strongly impressed upon planters that the smallest plants of every variety will be found to be the most profitable; being less liable to die during the early stages of growth, and, in after years, less likely to be overturned by wind storms. In the lower situations, and where rank herbage has to be contended with, transplanted plants may be necessary, but in all situations where the herbage is of a stunted nature, two-year seedlings of all the pine tribe will be more successful. On the higher ranges, where steep gradients are met with, seeding should be resorted to, and this more especially where rocky debris prevails. In such places no preparation is necessary, as the seed will get quickly covered by the natural process of disintegration.

As there are large areas in the Highlands highly suitable for the profitable growth of exotic conifers, these trees should be largely planted, giving *Pinus monticola* and other Pines light, deep, moderately dry soils; the Silver Firs, moist soils, with clayey subsoil; and the Spruce Fir tribe, the cool damp soils, including moss. But these exotics should only be planted where the situation is naturally well sheltered. In such situations, too, in well chosen soils, the *Wellingtonia gigantea* and *Sequoia sempervirens* should find a place. Where the forester, from practical experience, can satisfy himself on the points above cited, success is almost a certainty.

Planting.—There are various methods of successful planting. As a general rule the T*a* notch will be found suitable for two-year seedlings, twice transplanted, placing the plant in the slit *a*, which should be perpendicular to the prevailing wind. The same notch and the L notch are suitable for one-year seedlings, twice transplanted, and two-year seedlings, one year transplanted; while the ordinary Hand-iron is the proper implement to be used for all pine seedlings, except in extremely rocky situations, in which case the pick ought to be used. As the after success of a plantation largely depends on the manner in which the planting operations are carried out, the greatest care should be taken to have the roots of the plants properly placed under the surface. Larger plants than those above named should be pitted. This latter method is very expensive, and the after results are not any better, but often worse, than what are got by seedlings and small transplants. Where afforestation can be done by cuttings of such as elder, poplar, and willow, their propagation is so easy and certain that the cuttings should be placed in their permanent position at once.

The cost per acre of planting depends upon size, age, and variety of plants, together with the number of plants per acre, composition of the land, and the rate of wages in the district, and will be noticed further on.

While discussing the question of planting, it will not be out of place to consider the distribution of the plants. It has been found that the grouping system is the most natural and also the most profitable arrangement. This is to be observed all over Scotland, both in natural woods and in those planted by man. Whether in natural woods it is due to the survival of the fittest I am unable to say, but the grouping system is carried out by nature with unerring precision. It is therefore better to copy nature, and assist her as far as possible, and in few things is nature more grateful for assistance than in the making and management of woods.

The "survival of the fittest," or mixed system of planting, is that most generally practised, on account of its being thought that if one plant will not succeed another may. Under ordinary circumstances there is a good deal to be said in favour of this plan, but it is an expensive one, and usually gives the least margin of profit during the earlier stages of thinning. It is perhaps here that the practical and thoroughly experienced forester comes to the front, and plants only what he knows will pay best.

Seeding.—There are various methods by which the seeding of large areas may be accomplished, especially with birch, ash, beech, plane, elm, and pine, all of which are easily raised from seed, and more especially the birch. A cheap and very efficient plan is, scarifying the surface roughly with a log of wood, having its surface covered with iron spikes about 3 inches in length and 1 inch square; the log being about 6 feet in length by 8 or 9 inches in diameter, and having at one end a bolt, swivel eye, and chain for attaching a horse. This rude implement is easily dragged through rough land, or where a thick crop of heath has been burned. With a log of an oval shape, weighing about 2 cwts., the pulling strain will not exceed 12 cwts. A man and horse with such an implement should cover a very large area in a day, giving the land a double stroke, and keeping the lines about 3 feet apart. Under favourable circumstances about 8 acres can be accomplished, but 4 to 6 acres may be considered a fair day's work. It is an invaluable implement for raising shelter-belts for plantations on large areas of mountain, and will prepare a good bed for the seed of birch, beech, ash, elm, and pines. The implement was suggested by seeing the effect of dragging wood through forests for lotting for sale, and observing the after results by natural seeding. The cost of the implement, with chain complete, is about 25s., and any forester could make one on being supplied with the iron spikes by a blacksmith. The spikes should be 6 inches in length, to give them a firm hold in the log.

Where this implement cannot be got to work on account of the steepness of the ground, or because of boulders or rock, the mattock will be found to be best for good results. The operation with the mattock, however, is more expensive, as it will keep a man busy to do three-quarters of an acre per day of ten hours, seeding as he goes along; but the method can be made more economical by a boy sowing the seed after every two men. Where the ground is not covered with heath or herbage to any extent, broadcast sowing may be resorted to with good effect, especially on the face of steep slopes, and among disintegrating rocks. The action of natural agencies will soon cover the most of the seeds thus sown.

Sowing may be performed from January to June, according to the species, beginning with oak, mountain ash, etc., and ending with Scots elm, the seeds of which should be taken fresh from the tree about the middle of June. It requires at least ten times the number of seeds as that of plants to stock the same area of ground. On an average 2 lbs. of seed is sufficient for an imperial acre. When sown broadcast, the seeds should be mixed with some foreign substance to enable this small quantity (2 lbs.) to be properly spread over so large an area. Any friable substance will do for this purpose, provided the seeds are evenly mixed with it. Pine seeds should only be sown in the drier soils, such as those having good natural drainage, or on soils properly drained by artificial means.

Cost of Planting.—The cost of planting will be more clearly understood in tabular form, taking as our basis 640 acres, or one square mile, but a larger area costs proportionately less for fencing. On each acre the following average of plants and seed should be used:—50 hardwoods, 1000 larch, 3000 Scots fir, 250 Norway spruce, 100 silver fir, and seed as per table. In order to show a comparison of the cost of planting, etc., it is better that the cost of three sizes of plants should be given, as below.

TABLE I.

Four miles fencing, various, with gates, ...				£350	0	0
Cost of draining, average, ...				25	0	0
Cost of clearing land of rank herbage, ...				30	0	0
				£405	0	0
30,000 Hardwoods, various, at 7s. per 1000, .	£10	10	0			
600,000 Larch, 2 year-seedlings, at 10s. per 1000,	300	0	0			
1,800,000 Scots fir, 2 year-seedlings, at 4s. ,, .	360	0	0			
150,000 Spruce, 2 year-seedlings, at 3s. 6d. ,, .	26	5	0			
60,000 Silver fir, 2 year-seedlings, at 6s. ,, .	18	0	0			
				714	15	0
Carry forward, . . .				£1119	15	0

Brought forward, . .		£1119 15 0
Cost of seed for 40 acres—average		
Say 40 lbs. Birch, at 1s. 6d. per lb., . .	£3 0 0	
,, 40 lbs. native Scots fir, at 4s. per lb., .	8 0 0	
,, 20 lbs. Elm (Scotch), at 1s. per lb., . .	1 0 0	
,, 6 bushels Sycamore, at 2s. 6d. per bushel,	0 15 0	
		12 15 0
Cost of labour seeding 40 acres, ...		12 0 0
Cost of labour planting 600 acres with hand-iron, . . .		150 0 0
		£1294 10 0

Table II.

Cost of fencing, draining, etc., as in No. I., ...		£405 0 0
30,000 Hardwoods, various, at 17s. per 1000,	£25 10 0	
600,000 Larch, 2 year, 1 year transplanted, at 15s. per 1000, ...	450 0 0	
1,800,000 native Scots fir, 1 year transplanted, at 8s. per 1000, ...	720 0 0	
150,000 Norway spruce, 2 year, 4 years transplanted, at 15s. per 1000, .	112 10 0	
60,000 Silver fir, 9 to 12 inches, at 25s. per 1000, ...	75 0 0	
		1383 0 0
Cost of seed for 40 acres, as before, ...		12 15 0
Cost of labour seeding 40 acres, as before, ...		12 0 0
Cost of planting with garden spade, ...		240 0 0
		£2052 15 0

Table III.

Cost of fencing, draining, etc., as before, ...		£405 0 0
30,000 Hardwoods, various, at 17s. per 1000,	£25 10 0	
600,000 Larch, 2 year, 2 years transplanted, at 30s. per 1000, ...	900 0 0	
1,800,000 native Scots fir, 2 years transplanted, at 12s. per 1000, ...	1080 0 0	
150,000 Norway spruce, 2 years transplanted, at 20s. per 1000, ...	150 0 0	
60,000 Silver fir, at 30s. per 1000, . .	90 0 0	
		2245 10 0
Cost of seed, as before, ...		12 15 0
Cost of labour seeding, ...		12 0 0
Cost of planting with garden spade, ...		270 0 0
		£2945 5 0

It will be seen from the foregoing tables that the difference in cost between the formation of plantations by seedlings and transplanted plants is very great, and experience has proved that the results are anything but correspondingly good. On the contrary, in such places as this paper refers to, it is found that the larger the plants of the pine tribe used, the higher is the death-rate. This is due to the greater mutilation of the roots of the larger plants, parching of the plants by drying winds immediately after planting, and their liability to be shaken about and loosened by storms during the first year or two of their existence. These are facts so well known as to hardly require mentioning here; but, at the same time, while they are generally true, it sometimes happens that there may be spaces in large areas where it is necessary, from various causes, to plant larger plants than seedlings. Only where necessity demands it, however, should the system be practised.

It will be readily understood that the cost of stocking some kinds of land will be more than the estimates I have given, and some will be less, according to the cost of labour and other local circumstances. It must also be borne in mind that where such large numbers of plants are required, the cost of purchasing these may be reckoned as at least 10 per cent. less than the sums stated in the tables, which have been calculated at current prices; and in the seedling class a much greater reduction may be given on large orders. If orders be given two years in advance, as much as 40 per cent. of a reduction may be allowed, and this is a point worthy of the attention of those intending to plant on a large scale. That being so, the cost of plants under No. I. system would be reduced by £285, under No. II. system by £553, and No. III. by £898—a very considerable saving on initial cost, and in every way worthy of serious consideration.

It will be seen from the list of plants I have given that no note has been taken of exotics, but the reason for this is very obvious. I may say, however, that if early orders are given for these, a reduction in the price of 50 per cent. may be secured, thus lowering prices to a very reasonable figure. When it is borne in mind that about one hundred of these exotics are sufficient for an acre, mixed with larch, Scots fir, and silver fir, as nurses, it is not, after all, so very expensive to raise plantations of those trees in suitable soils and situations.

Management for first twenty years.—As to the proper management of the plantation during the period of twenty years after planting, much depends upon circumstances. Should the work be carried out in a general way, as indicated in the foregoing pages, very little will require to be done to the plantation for the first eight or ten years of its growth. The first thing necessary is to make good all deaths from whatever cause. This is more cheaply and effectually done two or three years after planting, because the blanks are then better seen. The next important point is to keep in repair fences and watercourses, artificial and natural, and this should continue till the plantation is at least twenty-five or thirty years old.

At eight to ten years of age those portions of the plantation that are on the lower ground, in good soil, and otherwise under favourable conditions, will require some thinning, or side pruning, as the case may be, the latter often being the more suitable. It need hardly be stated that the age of a plantation is no guide as to the proper time to thin, for much depends on the distance apart at which the plants were originally set, and the variety of plants, soils, and situations. Thinning should be done when the branches are beginning to interlace, and to such an extent as will allow a due amount of light and air to penetrate to all parts of the remaining plants. The least promising plants of every variety should be removed, even if those left should stand irregularly, for that can be rectified later on. When the intervening spaces are again closed up with growth, it is time to set about another thinning, and so on, till the final thinning takes place forty years or more afterwards. Hardwood plants are the better of being carefully trimmed during the first twenty years, with the pruning-knife. Prune so as to give the plants such form as may be desired.

With regard to plants that may have been raised from seed, they will require earlier attention to thinning than the planted trees. This is quite natural, because under ordinary circumstances, in five or six years there will be quite a thicket of plants, on account of the way the seed was sown. The weakest plants should be pulled out by the hand, except in the case of birch seedlings, which should be cut close over, and put up into small bundles of about 20 inches in girth. These are valuable for besoms, and are much sought after for that purpose by the cleansing committees of large towns. On this account birch seeding is the most profitable, because, if properly done, it will begin to pay well about its seventh year, and will repay all costs and interest before it is twelve years old, besides leaving a heavy crop on the ground to be dealt with after that age. Before it is twenty years old half the crop may be removed for making bobbins.

It is now necessary to give some indication of the *Cost of Management* of the plantation. This is difficult to do with any degree of accuracy. If there is only one area to be managed, and all of the same age, the expense will be greater than if there are several areas of different ages. Taking the area of 640 acres, and calculating from the average of similar plantations, the whole cost of management and maintenance may be estimated at 12s. per acre, or in all about £360. The thinning at about twenty years of age should pay itself, if the plantation is situated in a good locality. This is not the case as a general rule, but what the forester and the owner have to bear in mind, irrespective of profit from thinnings, is to thin in such a manner as will prevent injury from suffocation, and allow free circulation of air and light to the soil about the roots, so as to strengthen the latter against storms, and the possibility of the trees being upset by them. This done in proper time, the success of the plantation is assured.

XXIII. *Report on the Plantations on the Estate of Raynham, Norfolk.* By ARCHIBALD GORRIE.[1]

In compliance with instructions received, I inspected the various woods and plantations on the Marquis of Townshend's estate at Raynham, in the autumn of 1874, and reported as follows on their condition and future management:—

1. BIRCH WALK CLUMP.

This is a splendid clump of fine specimens of large, healthy, and ornamental trees. Some forty trees of various kinds, large in size and of great value, have been marked for felling. When this has been done, the clump will have a much finer effect from the Hall, near which it stands.

2. OLD NURSERY WOOD.

This plantation is composed of a rather large proportion of birch, and has been treated differently to the woods near the Hall, by removing many of the birch to make room for the more profitable trees—such as oak, ash, etc., which are very healthy and growing well. Marked 29 oak, 10 ash, 9 Spanish chestnut, and 3 silver fir for felling.

3. PLANTATION.

This is in a satisfactory state, and contains many fine trees of different kinds. The rows of beech on the outside are, however, somewhat coarse. This plantation should be laid down to pasture. Marked 27 fine oak, 15 beech, 2 ash, 2 Spanish chestnut, and 1 sycamore.

4. SHEREFORD PLANTATION.

This wood consists of a large quantity of valuable hardwoods—oak, Spanish chestnut, ash, beech, sycamore, etc.—besides numerous poles of various kinds. Marked 27 ash, 16 fine oak, 9 Spanish chestnut, 6 sycamore, 2 beech, and a large quantity of poles.

In these four plantations are found many well-grown, lofty, and robust trees in vigorous life, and growing fast into money. The marked trees and poles when removed will realise a large sum of

[1] Presented by Mr Archibald Gorrie, Brookmans Park, Hatfield, Herts.

money, and they can be well spared, with great benefit to the remaining trees.

5. The Kitchen Wood.

It is proposed to clear away as much of this wood as will square it with the west front of the Hall, as marked out by stakes on the ground. This will be a grand improvement, as it opens up a wide extent of splendid scenery. To obtain this result 60 oak, 5 Spanish chestnut, 1 sycamore, and 1 old lime tree will have to be felled. This lot, except the sycamore, should be sold to a timber merchant as it stands, who should be bound to grub-fell all the trees. I mention grub-felling in preference to the usual mode, as it is of the utmost importance that the ground should be carefully stubbed and cleared of all roots and weeds, and laid down with the best permanent grass seeds; and thus, in addition to greatly improving the view, the value of the pasturage would also be considerably enhanced.

Marked about forty fine trees in this wood outside of the line of the vista, but could not complete it owing to the abundance and strength of the underwood. Great care is necessary here to preserve only the best specimen trees, such as will improve the appearance of the lawn, and the thinning ought to extend over a period of eight or ten years, the ground to be ultimately cleared and laid down with permanent grass seeds and thrown into the adjoining pasture. The landscape would be much improved by clearing away the thorn hedge on the south side of this wood.

6. Young Kitchen Wood.

Several fine vistas from the Hall are projected through this division, and the trees to be felled carefully selected and marked. When opened up, the vistas will have a fine effect. There are some very large sycamores in this quarter, which, from injudicious pruning years ago, are unsound and fast losing value, and accordingly they are marked for conversion into money before they get to the price of firewood. Several of the best, however, are still very valuable, and will bring good prices, and their places will soon be well filled by the fine young trees that remain.

7. Pleasure Ground Plantation.

This consists of various kinds of forest trees, which, for want of being properly and timely thinned, are very much crowded, drawn up, and injured. The trees for felling have been carefully marked, so as to leave only the best specimens, and many years of careful management will be required to bring it into a perfect and profitable state. A large quantity of good larch, oak, ash, and sycamore, as also lots of poles, have been marked for felling, and all, except the oak, should be cut at once and removed before the wet weather sets in.

A great improvement will be effected here, by straightening and widening the present vista towards Hardlings, as marked out. When the timber has been removed, and the ground thoroughly cleaned, levelled, and properly laid down with fine lawn grass seeds, and kept closely mown, a very marked improvement will be apparent.

8. Pleasure Grounds—next Hardling Wood.

Oak and beech predominate in this section, and it requires to be carefully thinned in places ; but, owing to the impenetrable growth of underwood, the trees could not be marked.

9. Pleasure Grounds—Nursery to Kitchen Garden.

This plantation is very much drawn up and injured from overcrowding, but it has been partly thinned during the past two years. The whole has been closely inspected, and the trees marked that should be felled this winter to liberate the fine timber trees remaining. The youngest part of this wood has far too many laurels in it for either cover or ornament, and it is suggested to grub up full half of them, leaving the remainder in clumps of various sizes and shapes. This will give better cover for game, and be much more ornamental.

10. Pleasure Grounds—Flower Garden to Lodge Gate.

This consists of various kinds of very fine trees, but overcrowded and drawn up, and those to be felled could not be marked owing to the thick growth of underwood. The fine *Wellingtonia* by the side of the walk would be much improved with the admission of more air and light.

11. Belt from Hall to Stables.

Consists of oak, ash, elm, etc., all of which have been carefully inspected and marked, and a good view brought in from the gate and lawn in front of the Hall towards the lake.

12. Clump at back of Stables.

This has been well thinned so as to get the specimen trees to feather low, with a view to hide the stables from the road and other places. The fence round the clump might be removed with advantage.

13. Stables and Gas-House.

The stable yard is very much exposed towards the church, and to the roads to the Hall, and as the buildings are without architectural pretensions, it is desirable to screen them by planting nine or ten trees at the spots indicated by the pegs in the ground. The young lime trees around the moat, which appear to have been planted to hide the old houses, so beautifully mantled with ivy and presenting an extremely picturesque appearance, should be transplanted to more suitable places, excepting one or two next the gas-house and four or five next the waggon lodge, as pointed out to the forester.

14. Timber Yard and Haystacks, Carpenter's Shop.

These should be removed from their present sites, as planting them out cannot be recommended, because it would interfere very much with a charming view of the landscape across the lake and the beautiful scenery beyond. The building now used for a carpenter's shop is old and dilapidated, and from want of room and light it is ill adapted for men to work in. It is therefore suggested that it should be cleared away and a new one erected as near the sawmill, and as much out of view, as possible, taking care to secure a convenient site, with sufficient space for storing rough timber. If this plan is adopted, the hay can be stacked on or near the site of the present carpenter's shop; and then there will be no necessity to plant trees where the stakes are put in at the back of the stables, especially as every tree there planted would interfere very much in course of time with the view of much interesting scenery. By the removal of these unsightly objects the results would be in every way most satisfactory.

15. Park, north side of Lake.

All along the north side of the lake there is a jumble of fine young oak, elm, beech, etc., much too thick for park trees. A number have therefore been marked, with a view to improve both the landscape and the pasture. When they are removed it will give a fine effect from the West Raynham approach, more especially if the lake is cleaned out, as I consider that no landscape view can be reckoned complete in which water does not form a part, and when it does exist it ought always to be made the most of.

16. Hardling's Pasture.

This is also a perfect jumble of fine young park trees growing into one another, and require to be well opened up to show the beautiful landscape they now shut out from the West Raynham entrance. A number of trees have been marked, and when they are removed, it may be found necessary to take down more, to open up the beautiful scenery.

17. Trees near the Church.

Several of the trees around the church have been marked, which, when felled, will show a great improvement. I would suggest that the Irish yew in the churchyard be transplanted, or cut down, as it quite obstructs a charming view from the church door.

18. Mr Savory's Pasture.

This division is well furnished with splendid park trees, and forms a fine feature in the landscape viewed from the opposite side of the lake near the Hall. The horse-chestnuts, limes, elms, and walnuts would be difficult to match anywhere else. Marked ten trees for felling; and great care will be necessary in marking any more, for fear of showing the village from the Hall.

19. Belt by side of Lake.

This should be carefully thinned, and put into Mr Savory's pasture as far as the osier bed. Great care must be taken to leave only the best of the outside trees.

20. Round Bush Plantation.

Consists of oak, ash, beech, elm, etc., very much drawn up. It should be thinned gradually, with great care, every two or three years, till only the best trees are left.

21. Brick-kiln Plantation.

This is similar to the last, and the same remarks apply. After being properly thinned, both should be put into the adjoining pastures.

22. Mr Butcher's Meadow, near Hill Houghton.

Marked twenty-seven good trees in this meadow. In the corner of the meadow, next the village, are some splendid trees, in a very healthy state.

23. Galonel Fifteen-Acre Plantation.

The middle of this wood consists of very fine old oak, ash, beech, and sycamore; and it is recommended that several of the beech be felled, as they are interfering with the growth of the more profitable timber. The young part of the wood is being much injured for want of thinning, and requires immediate attention to that operation.

24. Wood by Lodge next Fakenham Road.

Marked thirty trees of various kinds in this wood, leaving only the best park trees, with the view of improving the appearance of the place when the marked trees are removed. Other places require more immediate attention to thinning than this, but it should not be too long postponed, else evil will result.

25. Entrance Lodge to Hall—from Fakenham Road.

The belt on the right side going to the Hall has had trees marked at several points, to break up the monotony of the long even line of plantation. On the left side several trees have been marked. When these are all removed, some beautiful glimpses of scenery will be opened to view from the drive. The unsightly and inconvenient gate which crosses this approach, and the fence dividing the park, are very undesirable, and should be removed. The whole might then be pastured with sheep, if cattle are an objection near to the mansion. The appearance of the park would be very much improved thereby, and much convenience gained.

26. Old Clump of Trees in the Park.

Marked thirteen trees in this clump, which has a ripe and rather stunted-in-growth appearance, and probably several more trees might be taken down.

27. Round Clump in Mr Case's Pasture.

In this meadow, marked six ash and five oak trees for felling.

28. The V Plantation.

This plantation is getting too much drawn up, and ought to be thinned at once, although the small oaks will not pay for felling. The same remarks apply to the young clump next to it, only, as many of the Scots fir as will make good trees should be left, as the extensive park is deficient of evergreen trees.

29. Young Plantation from Shereford Wood to Fakenham Road.

It is to be regretted that in this extensive plantation nearly all the young trees are too much drawn up, and it is suggested that all the parts which have been thinned during the past two or three years should be gone over again immediately, leaving the Scots fir where possible, and carefully thinning out the others. The sacrifice of a little bark on the underwood is really unimportant, compared to the great benefit that will accrue to the growing crop of timber, by timely and repeated thinning, and especially when the young trees have been previously neglected.

A row of full-grown beech runs along the south side of this plantation, beginning at the Shereford end, which might be sold, as they are injuring the young trees, and they are not required for the landscape, as the young plantation would immediately take their place. There are also three rows of ash, on the park side of the plantation, opposite the beech, of which the inside row would be better removed, because if it remains it will ultimately injure the live fence. A good wide drive, or ride, from one end of this plantation to the other would be highly beneficial. It should be run as near the middle of the wood as possible, so as to be convenient for getting out the timber, as well as for shooting and other purposes.

30. Clump next Mr Bate's Pasture.

This clump, by the side of Mr Bate's pasture, next the Fakenham Road, is composed of fine young trees, which are, however, far too much drawn up. It should be thinned properly, and then put into Mr Bate's pasture, as, from its proximity to the road, it cannot be of any use for cover.

31. Mill Hill Cover—from Public Road to Rose Green.

This large young wood is chiefly composed of oak, very much crowded and drawn up. It should be treated in the same manner as recommended for No. 29—the young plantation from Shereford Wood to the Fakenham Road. A good drive is also very much wanted in this plantation.

32. Manby's Car.

This wood consists of oak, ash, elm, beech, alder, larch, spruce, Scots fir, and a considerable number of very fine, sound, healthy poplars, which are growing fast. With the exception of the poplars, the trees have been badly neglected, and in consequence are much drawn up in many places. No time should be lost in commencing to thin; and many of the poles, being clean and straight, would sell well. The wood might be divided, for convenience in working, into four or five falls, taking one each year, and beginning where the poles are most crowded.

33. Messrs Norton and Overman's Meadows.

Examined the large poplars in these meadows, and found many of them beginning to decay and obviously losing value, I marked forty-three trees, some of them of a very large size. Owing to the wet, unsound nature of the ground, which will never be drier than at present, it would be better to get the trees removed at once, before wet, wintry weather comes. As the forester has so much work on his hands at present, and likely to have more, it would be best to sell the poplars as they stand to a timber merchant, to take them down and remove them at his own expense.

34. Mr Beart's Pasture.

Marked a very large ash and a large walnut, both of which are beginning to decay; also twenty-five other trees, which, when taken down, will not only improve the landscape, but be also very beneficial to the pasturage.

35. Norman's Borrough.

Part of this wood, behind the keeper's house, was thinned about four years ago. The fir division requires immediate attention, the trees in which are of great length, and useful for building and other purposes, and a large number might be taken out with much benefit to the remaining crop. There are a great number of fine young oaks, and of young firs of several kinds, which require more light and air for their development. More attention should also be given to the formation of better drives, as good roads through all woods add considerably to their value. The soil being of a peaty nature by the roadside, near the Horse Shoe Inn, it is very suitable for growing rhododendrons, which would make excellent cover and be very ornamental.

36. Raby Wood.

This wood is partly old and partly young, and chiefly composed of oak. A considerable quantity of fine timber might be taken out of the older part, with much benefit to the remainder. The young oaks are much drawn from crowding, and require very careful attention. The drive in this wood should be altered to a more convenient position.

37. Ash Car.

Consists principally of ash, oak, alder, and fir. There is also a number of sound poplars of a large size. This division, like nearly all the others on the estate, requires immediate thinning. Many of the poles are very good, and will pay well for cutting.

38. Rudham Grange—Mr Savory's Farm.

Marked all the trees necessary to be felled around the premises, and in the meadows. It is a great pity that these trees have been so badly neglected. In marking them, special attention was paid to shelter, and to the landscape effect, which will come out well when the trees are cleared away. There will be enough of timber here for an auction sale.

39. Coxford Plantation.

Considering the poverty of the soil, this is a very satisfactory wood, and consists of fine old Scots fir, oak, beech, etc., and in a few places a little thinning would be beneficial. The Scots fir is in large fine lengths of first-rate quality, and very valuable for building and many other purposes. As trees thrive so well on this poor soil, it would be a great improvement, and a highly remunerative investment, to plant extensively in this district. As there is so much oak and other hardwood plantations on the estate already, and no young fir woods of any extent, it would be advisable to plant here only the fir tribe, introducing among them a fair sprinkling of the most suitable of the newer conifers.

Judging from this fine old plantation, it is quite clear that the profits of planting such land would be great. Pleasure alone may satiate; but when pleasure is combined with profit, their union invariably affords a lasting source of gratification to the happy possessor.

XXIV. *The Island of Arran as a Field for Planting.* By W. A. Mackenzie, Strabane, Brodick, Isle of Arran.

In Firth of Clyde, on the west coast of Scotland, lies the Island of Arran. It is about fourteen miles west from the Ayrshire coast, and about six miles east from Kintyre, the southern part of Argyllshire. Its form is that of an irregular ellipse, having its greatest length of about twenty miles from north to south, with an average breadth of a little over ten miles. A country in itself as regards its physical conditions, it may be said to contain on a small scale every characteristic of the adjoining mainland, from the bleak and sterile climate of the Grampian range of mountains to the soft and balmy breezes of the south of England—the high, heather-clad hills of the Scottish Highlands, to the gently undulating plains of the south. The great variety of its climate makes Arran an interesting field for botanists, for here are to be found specimens of nearly all the flora of the British Islands; and those who are lovers of botanical research will certainly be well rewarded by a visit to this picturesque and attractive retreat. To the arboriculturist, too, who mourns the amount of waste land that might profitably be clothed with timber, Arran would not be altogether devoid of interest. In it are many acres of wild, uncultivated land that at present yield no return, further, perhaps, than some grouse and a few deer, which could be planted with trees that in the course of time would well repay the cost, sufficient proof of which is seen in the several thriving patches of wood that already adorn some of its mountain slopes.

Before entering into the arboriculture of the island, or its admirable adaptability as a field for planting, it will be necessary to consider for a little its geological formation, together with its geographical position and physical character. The physical character is practically due to the geological structure, for it is its geological structure that makes the physical features of the island of so marked a character, and gives rise to its extreme diversities of soil and climate. In the north are high and precipitous mountains, embosomed among which are wild and romantic glens, with beautiful streams rushing impetuously towards the sea. Towards the south the hills are much less lofty, and spread out below into broad undulating plains, which stretch on all sides seaward, and are divided into fields and meadows of considerable fertility. The variety of the geological formation produces a corresponding diversity in the soil, and the physiological character a marked influence on the climate. Apart from these, however, its geographical position bears very directly on its climate, for, situated as it is almost on the verge of the Atlantic, the island enjoys a much greater uniformity of temperature, and a more copious rainfall, than almost any other place in Scotland; and as these are very important factors in the rearing of forests and the production of timber, it follows that if the soil is suitable arboriculture could be very successfully practised.

Including, as it does, the granite, slate, old and new red sandstone, whinstone, lime, hornblend, porphyry, quartz, basalt, claystone, pitchstone, and various sections of the Coal formation, including shale, Arran may be said to be quite a geological museum; but it is not needful to go minutely into the geological details of the island. For my purpose it will be sufficient to divide the island into two parts—a northern and a southern, of nearly equal area. The northern portion is mainly composed of granite, slate, and old red sandstone; while the southern consists principally of the Carboniferous series, with porphyry, greenstone, basalt, etc., and the disintegration of these different rocks has given to the soil of Arran its present character. The lapse of time has in many places covered the rock with rich alluvial soil, in some parts attaining the depth of many feet, and generally of sufficient depth to grow large sized forest trees.

From what is indicated above, it will be quite understood that the variety of soil to be found in the island is very great. About Brodick it is of a loamy nature—argillaceous in places—while farther south it becomes of a lighter and more sandy character, but with patches of alluvial loam interspersed throughout. The subsoil is generally of a gravelly marl. In the southern parts of the island the soil is of a clayey consistency, and the subsoil is also clay mixed with gravel and sand, and very retentive of water. The western side of the island is gravelly and moorish, but with frequent patches of excellent alluvial soil. In the northern parts the soil is generally of a light sandy nature.

Perhaps it might be argued that the physical features of Arran are not such as to encourage any desire to plant timber, for its exposure to the Atlantic gales, and the lie of its principal mountain ranges, are not very favourable for forest culture. This difficulty, however, is not so real as apparent, and could easily be overcome by careful and judicious selection, and planting of "shelter-belts" of those trees best suited for exposed maritime situations, and once established, forests of finer varieties would rise up in the shelter of those belts. Notwithstanding that some of the mountain ranges run in a south-west and north-east direction, many quiet and sheltered glens, lying at right angles to the prevailing winds, might well be clad with timber; and those less favourably situated could also be adapted to the same useful purpose of timber production by the sheltering method above suggested.

Including the islets of Holy Isle and Pladda, Arran has an area of 103,950 acres. Of this, at present about 23,000 acres are under arable and pasture lands, 2300 acres under roads, water, etc., and about 1360 acres under wood, thus leaving over 77,000 acres lying waste, and crying out to be dealt with in some profitable manner. That the whole of this could be profitably planted is of course an impossibility, but many acres which at present yield no appreciable return could be utilised for sylviculture, and made a profitable field for the capitalist who might feel inclined to lay out his money in such an investment. In the northern parts of the island there is a large area that could not possibly be made to grow timber—a great part of the land lying upwards of 1000 feet above sea-level, and having no depth of soil. In many places, in fact, there is nothing but bare rocks and beds of shingle. Up to a certain altitude these places could be sown with the seeds of trees suitable for the climate. The southern part, however, is not quite so hostile to vegetation, for the hills have a less altitude, in few cases reaching over 1200 feet, and in several instances clothed with grass to their very summits. Neither is the bare rock so extensive, and in many parts natural wood has already taken possession of the ground. But although that is the case, the southern portion of the island is not nearly so suitable for timber growing as the northern, for, owing to the manner in which the ground slopes on all sides to the sea, the exposure is so great as to make it next to impossible to grow any kind of timber except that of the trees best suited for maritime situations. It would be unreasonable, then, to suppose that the whole of the 77,000 acres, or anything like that area, could be planted, but suppose that one-fourth (a very moderate estimate) could be utilised for forest culture, what a material increase there would be in the comparative value of Arran. Of the 77,000 acres of waste, we may then say that one-fourth is at too high an altitude for planting, while one-half is of such a nature, either from exposure, or variety, or depth of soil, as would render it also unsuitable. The remaining fourth could, I have no hesitation in affirming, be converted from a wild waste into flourishing forests, thereby adding beauty to the landscape, and giving the shelter so necessary to many parts of the island.

To understand properly what the future of forestry in Arran might be, or what Arran is as a field for sylviculture, it will be necessary to consider its present state, and to look into the condition and prospects of the woods now existing on the island. Besides the 1360 acres which have been planted, and which will be considered in detail, several tracts of natural wood are to be found, but these are not of sufficient consequence to demand much attention. They consist principally of birch, with here and there some hazel, elm, oak, mountain ash, etc., in few places reaching sufficient size to come under the category of timber trees; but these natural productions prove the suitability of the soil and climate for afforestation. Of these the birch (*Betula alba*) is the commonest tree. Although there is a considerable quantity of natural birch, it is not now of much commercial value in Arran.

In many places near the coast natural coppice grows luxuriantly, and in some of the more inland parts, too, it is found in a thriving condition. In wet parts, and on the banks of the small rivers, the alder grows abundantly, but attains no great size.

The ash, which grows well on the same soil, is found to be a better paying tree, but through inattention it does not nearly reach its full size, although in some cases very good timber is got. For instance, one ash tree measured, and by no means the largest met with, contained 20 cubic feet of good sound timber. Oak does not thrive very well, taking the island as a whole, but near Brodick some large trunks are to be found, for where sheltered it grows very well, and at the present time is being planted in several favourable situations. The natural oak, however, seldom attains to such dimensions as to be of any importance, and is not sufficiently plentiful to be of much value as coppice.

Among the other trees that grow naturally may be mentioned the elm, beech, sycamore, mountain ash, and poplar, but the natural specimens of these trees are comparatively diminutive, and hardly worthy of attention. Those trees of the same kinds which have been planted, however, go to prove that their cultivation would be a success if judiciously practised.

It might be interesting to mention here a few of the rarer exotic trees and shrubs that are to be found growing and flourishing on the island. Of these, perhaps the most noteworthy is the "Blue Gum" of Tasmania, *Eucalyptus globulus*, several of which are growing in favoured situations. At Lamlash are two of these trees, one the largest on the island, growing in the grounds of Craigard House. They are said to have been planted some twenty years ago, and the larger is now about 30 feet in height. This tree was unfortunately blown down during the heavy gale last October, but by the instructions of Captain Brown it has been raised very carefully, and may be little the worse for the misfortune. Smaller specimens of the *Eucalyptus* are growing at Corrie and Strabane, the Corrie ones coming next in size to those at Lamlash. At Corrie there are also two of the Australian tree fern, *Dicksonia antiartica*, with several Australian palms, and acacias, all in a thriving condition. The fuchsia grows very abundantly in the grounds around Brodick Castle, and is to be met with in quantity in other parts of Arran. At Strabane there is a small apple tree upon which mistletoe is flourishing.

From these facts, and looking to the delicate constitution of some of the plants mentioned, it is not difficult to conclude that the climate of Arran is a very mild one, and in every way favourable to the growth of trees and shrubs. When these delicate plants, natives of a warmer and more genial climate than Britain can boast of, grow with such luxuriance in the open air, surely the hardier timber trees, natives of this and even more ungenial climates, could be made to grow with great profit to the owner. In further proof of this, let us now consider in detail the present plantations in Arran.

I. The Merkland Wood, situated immediately to the back of Brodick Castle, is by far the largest plantation in Arran, and covers nearly 500 acres. It was formed seventy-five years ago, and all the plants were pitted. The soil is of a calcareo-argillaceous nature. This wood contains larch, silver fir, spruce, oak, ash, beech, and a few other kinds, but the principal trees are larch and silver fir. The silver fir grows with remarkable vigour, and has attained very large proportions, in some cases measuring upwards of 100 feet in height, and 8 feet in girth at 5 feet from the ground.

A number of these large trees were blown down by recent storms, and some of them contained over 100 cubic feet of timber. Five trunks were measured, and they were found to contain 136, 118, 107, 100, and 94 cubic feet. Several of the standing specimens measure over 150 cubic feet, and one of the largest, but of earlier planting, contains 400 cubic feet. The larch also thrives remarkably well, and yields a fair quantity of saleable timber. Growing upwards of 75 feet high, and measuring from 3 to 6 feet in girth at 5 feet up, the trees contain on an average from 25 to 30 cubic feet of timber. Besides the silver fir and larch, the Scots fir grows well, but not to so great size. Spruce is a better grower, and attains larger proportions, the cubic contents of many of the trees being about 40 feet.

Deciduous trees do not grow nearly so well as the conifers, although beech, oak, and sycamore constitute a fair proportion of the wood.

II. The Glenrosa and Glensherrig Wood, consisting mainly of larch and Scots fir, was planted about fifty-four years ago, and has grown well. At the present time it has reached its maximum value, for the larch is ripe and ought to be felled, as some of the trees are beginning to decay. A large number of the larch trees contain over 20 cubic feet, while some contain as much as 40 to 50 cubic feet. The Scots fir are similar to those in Merkland Wood. This wood covers the south-eastern and north-eastern slopes of the Glenrosa and Glensherrig Hill, and reaches to about 800 feet above the level of the sea, at which height the trees are growing splendidly. The soil is of a clayey nature, with a rocky subsoil at no great depth.

III. Immediately to the west of Merkland Wood, and growing on a similar soil resting on rock, is the Stronach Wood, consisting of two divisions of various ages. Both divisions are growing well, and contain quite a variety of trees—larch, silver fir, and Scots fir being the principal crop. The younger portion is thirty-four years of age, and contains some very promising larch; the older portion is ready for felling, most of the trees being ripe.

IV. In the neighbourhood of Brodick there is another section called Strathwhillan and Corrygills Wood. Larch and Scots fir here again constitute the bulk of the crop. It was planted thirty-three years ago, and is growing remarkably well.

V. Glen Ashdale Wood is the only other wood in Arran of any size. It was planted thirty-five years ago, and is growing very well. Larch is the principal tree, and the wood is in a very healthy condition, there being many of the trees over 50 feet in height. Ash grows well in the lower parts of this wood.

Besides the foregoing, there are numerous small patches of wood at Lagg, Sannox, Machrie, Whitefarlane, and other parts of the island, and an examination of these, together with those I have mentioned, would fully convince the most sceptical of the adaptability of the island for the growth of timber trees.

To plant to the greatest advantage, a careful choice and arrangement of trees would have to be made, for those best suited for one part of the island might not suit another part with a different exposure. The most difficult part of the island to deal with would be the southern portion, for, as I have already said, this section is more exposed to the fierce Atlantic storms than is the northern part. Round the shores of the south there are arable and pasture farms, but at a short distance inland the land is lying waste, or very nearly so, and could be easily made to grow timber. Shelter-belts could be raised round the outside and in exposed places, and with the protection of these many valuable kinds of trees could be raised. These shelter-belts should consist of the following trees and shrubs, in the order given :—1st, outside, a belt of sea buckthorn, about 3 yards deep; 2nd, a belt of elder, about 3 yards. Inside of these there should be a belt of sycamore with beech still farther inland. These trees would grow in any exposure in this arrangement, and within these the pines and future timber trees might safely be planted. This method of raising shelter would require to be practised all over the island, but more particularly in the south. Many of the more sheltered glens, however, could be planted without any preliminary treatment of this kind, and would grow excellent timber. Glenrosa, for instance, has only been partly planted, and the trees have grown exceedingly well. There is also a large part of Glensherrig still uncovered with wood, which might well be planted without any shelter, and many other places could easily be seeded.

Judging by the trees now growing in the island, the best kinds to plant are larch, silver fir, Scots pine, spruce, and such deciduous trees as ash, beech, sycamore, etc. A mixture of these would generally be the best,—but in some parts the larch thrives so well that it seeds and grows spontaneously, and as it is one of the trees best adapted for Arran, and also one of the most profitable of timber producing trees, it should form a large proportion of any mixed plantation.

An average of 3500 plants is sufficient for an acre, and the following would form a very good mixture:—

Scots fir,	1000
Larch,	750
Pinaster,	500
Spruce,	500
Silver fir,	250
Beech,	200
Laricio,	200
Douglas fir,	100
	3500

These plants should be what is known as two-year, one year transplanted, and would not cost more than £3, 5s. per acre.

That this mixture would be suitable for the whole island is certainly impracticable, but for a large part it would be quite appropriate, grouping the kinds as required.

While this table is given as a guide, it should by no means be practised over the whole breadth of the island, where planting can be executed with profit. Generally speaking, where the herbage permits, nothing larger should be planted than two-year seedlings, silver fir excepted. In the exposed situations having light sandy soils, plant *Pinus Pinaster* and *P. Laricio;* where the soil is light and thin, among rock debris, in crevices, and such places, sow such seeds as are suitable for the spot, giving of pine seeds 2½ lbs. to the acre, mixed with the seeds of the broom to make them spread properly. Seeding is the most natural, and under certain circumstances the least expensive method of stocking the ground, with the best results. Next to seeding comes seedling plants, either one or two years old, the good results from which are assured by the woods that have been cut down during the early part of the present century. The least profitable of all methods is the transplanting of large plants; the future growth and ultimate success of the trees so planted being governed by the size and age at which they were transplanted. The less frequently forest trees are handled, the less liable are they in after years to fall victims to diseases of the roots, and other ills now so prevalent.

Taking the island as a whole, a large part of it could be planted without any preliminary preparations except the shelter-belts, and even in some instances they could be dispensed with. Some parts however, otherwise suitable, might be found to be too wet, and a certain amount of draining would be necessary: about one quarter of the whole area available for planting would require this kind of treatment. In addition to draining, some fencing would be required, and the fences should either be dry stone dykes or wire, the former being the more serviceable, as they would form good shelter for the young plantations. The fences surrounding the existing woods are chiefly dry stone dykes, with, in a few instances, a wire running along the top. The expense of the fencing, however, would not be very heavy, and on the average the total cost of stocking an acre, including plants, labour, etc., would not greatly exceed £5. This outlay would be well repaid in a few years, not only by the sale of the produce, but also by the shelter given to stock and crops, which would materially improve both, greatly to the advantage of the agricultural community, and to the amenity of the island.

XXV. *Remarks on the Planting of the Sandhills on the Sea-Coast at Holkham, Norfolk.* By Archibald Gorrie.[1]

Holkham Sandhills, the property of the Right Honourable the Earl of Leicester, K.G., were rabbit warrens until the year 1850. They extend about 3½ miles along the Norfolk coast, from 5 to 25 chains wide, bounded by the German Ocean on the north, and on the south by rich pasture land reclaimed from the sea, dating as far back as 1660, when the first enclosure was made. These hills are held together by a plant called *Psamma arenarius*, which has a strong creeping perennial root, with many tubers at the joints about the size of a pea. It is planted and encouraged on the Norfolk coast to aid in fixing the sand against the action of the wind and tides, which it does in a remarkable manner. The "marrum," as it is locally called, or Bent-grass, is considered of so much importance that there are severe laws to prohibit its being destroyed. Mats are made of it, and it is also used as thatch.

Elymus arenarius, the Sea Lyme-grass, a strong, rough, glaucous plant, common on sandy shores, is also frequent here, and answers the same purpose in fixing the sand as the "marrum." In analysing the soluble matter afforded by this grass, Sir H. Davy found it to contain more than one-third of its weight in sugar. It is not, however, eaten by any of our domestic animals.

About 1850 I sowed several kinds of pine seeds on the sand-hills, putting some of the seeds in small pellets of clay and inserting them in the sand, and in various other ways. I did this for two or three years in succession, but it ended in failure. I then planted a few plants of well-established *Pinus austriaca*, *P. Laricio*, and Scots fir, and had them thoroughly protected from rabbits, never thinking they would do much good in the pure sand, but I was agreeably surprised at the end of the first season. The plants all lived and made one or two inches of young wood, and seemed healthy; the second year they did better, when I drew the Earl of Leicester's attention to the matter, and he was so satisfied with the growth of the trees that were planted that he at once set about destroying the rabbits, and planted a small portion of the hills every year till the whole is now completed.

The east end of the hills, nearly two miles in length, which was

[1] Presented by Mr Archibald Gorrie, Brookmans Park, Hatfield, Herts.

only partly planted previous to 1875, is a very thrifty young plantation, not only being a shelter for the adjoining pasture, but forming a grand and peculiar feature in the landscape, and the trees doing much better than the most sanguine could expect.

Mr Munro, the Earl of Leicester's intelligent forester, writes to me about this division of the hills, and says: "When he came to Holkham in 1877, the trees in many cases were very good, but the tops of the *Pinus Laricio* were very much cut with the northerly winds and blowing sands. He at once commenced planting the tops of the hills, principally with *P. austriaca* and a sprinking of *P. maritima.* When these got hold and began to get up, the *Laricio,* which were cut by wind, began to improve, and by 1882 a very decided improvement was visible. Since then, seeing the progress the plantations made, he went on extending them, until the area planted is now double what it was in 1882."

The proportions in which the plants are used are—

Pinus Laricio,	50	per cent.,	planted	8 yards apart.
„ *austriaca,*	25	„	„	5 to 7 yards apart.
„ *sylvestris,*	20	„	„	„ „
„ *maritima,*	5	„	„	„ „

Let it be distinctly understood that the plantations are ornamental, and are not planted for profit, hence the distance between the trees, giving plenty room for developing their laterals. The *austriaca* and *maritima,* being on the higher and more exposed situations, and fully exposed to every storm from the German Ocean, are planted 5 to 7 yards apart, as they cannot possibly make the same growth as the *Laricio,* which are more sheltered. The *Laricio* are now in many cases 30 to 35 feet high, their lateral branches covering an area equal to a circle of 8 yards in diameter, and are full of health. The Scots fir and *austriaca* are making a proportionate growth. When at Holkham last spring, Mr Munro had just finished planting a large area of the West Sandhills, and, notwithstanding the previous cold and unpropitious winter and spring, I only saw a single dead plant, which reflects great credit on Mr Munro's management.

Altogether this is a most interesting item in forestry, but I am not aware of any notice of this or similar undertakings having been mentioned in any British work on forestry. Professor Wagner, however, writing to the Prussian Minister of Agriculture, and recommending to him the cultivation of *Lathyrus sylvestris*, a strong perennial rooted species of the Everlasting Pea tribe, for the immense area of barren sandhills along the coast of Northern Germany, points out that it would form a far superior means for bringing these vast wastes under profitable and permanent cultivation than the planting of pine and fir trees. Little faith was, however, put in that statement, until its correctness had been visibly proved on a large scale by Imperial Privy Councillor of Commerce, Otto Kuchnemann, of Stettin, Pommerania, Germany, who had for many years, and at heavy expense, endeavoured to grow on his sandhills pine and fir trees, but had failed to succeed, the young trees being partly smothered or uprooted by the ever-shifting sand, and those surviving were vegetating so weakly that the attempt was tantamount to failure. Now a flock of sheep is kept on the *Lathyrus* fodder grown on the identical sandhills where six years ago not a blade of grass could be seen.

XXVI. *Our Timber Supplies from Abroad.* By A. T. Williamson, Kew Terrace, Edinburgh.

This subject is of the greatest interest and importance, not only to those immediately associated with the production and consumption of timber, but to every member of the community. There is very great difficulty in arriving at the exact value of the wood imported into this country, but, on a fairly accurate calculation, it may be set down at £20,000,000 annually. The returns periodically issued by the Board of Trade afford an idea of the number of loads, and the figures given in this paper show the vast and far-reaching influence which timber has upon our national industries. There is no doubt that trade in timber is largely influenced by the condition of other trades; but, at the same time, it has to be borne in mind that our timber supplies have a very important influence on other trades. It is often supposed that for many purposes wood cannot be superseded by any other material, but this is entirely erroneous. It is in a large degree dependent upon the facilities by which timber can be supplied whether or not the same proportion shall be consumed. In many branches of industry timber finds a keen competitor in iron, in some instances in brick, and occasionally in stone. In these cases the ultimate consideration with the consumer is the question of cost. That the use of timber has enormously increased is clearly seen by the figures that follow; and this expansion is largely due to the ingenuity of those associated with timber production, in introducing such inventions and facilities as enables it to successfully compete in price with other materials. The credit of producing this result is to be shared alike by the forester, the timber merchant, and the timber manufacturer. The timber merchant, it may be said, is merely the distributor, and has little influence in guiding either the production or consumption. This may be true as regards the merchant in other commodities, but, as will be seen in the following remarks, the merchant in timber has had a very great influence in the development of the trade.

In the year 1890 the total imports from foreign countries and the colonies amounted to 7,056,688 loads. This was made up of 2,278,374 loads of hewn or rough log timber, and 4,778,314 loads of sawn and manufactured wood. These figures show the large proportion that is brought in a prepared and partially prepared condition, being fully double the quantity imported in its raw state. This is a condition to be regretted on many grounds. The amount of money represented in the manufacturing cannot be less than £3,000,000, a sum which one would think might easily be conserved to our own workmen. The cost of freight for waste and superfluous wood is saved when it is in a manufactured state, but the superiority of our workmen, and the greater excellence of their workmanship, should and does more than compensate for this item. This has been proved by years of practical experience in the large quantities of manufactured flooring and lining that is sent to the Australian markets, not from Sweden, but from Scotland, the timber being first imported from Sweden into Scotland, prepared here, and then exported again to Australia.

It may be interesting to look at the enormous development of the import of manufactured timber in the past thirty years. Although statistics of any value are difficult to procure, we have been able to get a fairly approximate table for London, which represents something like one-fifth of the whole country, and which may therefore give a fair idea of the whole. The increase in the total imports has been practically steady and continuous, but, looking at the raw timber by itself, it has remained stationary, or has had a backward tendency. For 1860, the number of loads of hewn timber was 233,000; for 1890, the number of loads of similar timber was 219,700. The quantity of sawn or manufactured timber bears a very marked contrast with this. In 1860, manufactured timber was imported to the extent of 7,125,000 pieces, while in 1890 they had grown to no less than 33,198,000 pieces. This advance has been a gradual one throughout the thirty years, each year as nearly as possible adding 10 per cent. to its predecessor.

We have given the total imports for 1890, viz., 7,056,688 loads. Deducting from this 507,058 loads of furniture woods from various countries, 6,549,630 loads remain of the more common supplies. These imports, chiefly drawn from Scandinavia, Russia, Germany, and British North America, are made up as follows:—

Scandinavia, . . .	2,643,666	loads.
Russia, ...	1,519,174	,,
Germany, . . .	287,482	,,
British North America, . .	1,366,671	,,
All other countries, . .	733,637	,,

It is thus seen that Norway and Sweden furnish us with about 40 per cent. of our timber supplies, and the 2,643,666 loads sent to us are made up of 673,305 loads of rough and 1,970,361 loads of manufactured timber.

The question may naturally be put—Why is Scandinavian timber so much favoured by us? It must be better or cheaper, but that is only true to a limited extent. The great development of Swedish imports is a matter of only recent years. It is impossible to make an accurate comparison of the qualities of imported timber, treating it nationally, because the shipments of some ports are superior to the shipments of other ports in the same country; but, on the whole, the balance of quality in respect of both the Scots fir and the spruce, which form 90 per cent. of the imports, is considerably in favour of Russia. The freight from Russian ports is also generally from 10 per cent. to 15 per cent. lower than from the upper ports of Sweden, whence the larger bulk is shipped. The Swedes, however, have displayed characteristic enterprise in adapting their conditions to meet the situation. They have greatly improved their machinery, more carefully selected their timber, and lowered their prices so as to secure British orders, and have thus equalised matters with their Russian competitors. Not content, however, with having placed themselves on an equal footing with Russia, they have turned the scale in their favour in the eyes of the British buyer by granting six months' credit on all transactions, the Russians being unable or unwilling to give more than three months. It is in this way that the merchant has had so much influence on the development of the trade, to which we made allusion in the early part of this paper. These specially favourable terms induced an accumulation of stock in our merchants' hands, and allowed them to place before the consumer, in the most favourable light, the merits of Swedish supplies, and generally influenced their use.

The question arising here is, of course,—Can Sweden maintain the annual output of such enormous quantities of timber? The answer is generally admitted to be, on the whole, in the affirmative. Great Britain and Ireland receive one-half of the total quantity of wood shipped; and, when the vast area is considered, it must be admitted that even the figures given are only capable of clearing out the woods of a comparatively limited area; and Scots fir and spruce being fast-growing trees, the re-afforestation is proceeding as quickly as the deforestation.

The Russian supplies come second in their amount. These are represented by shipments chiefly from Riga, Cronstadt, and Archangel. The Riga shipments are principally composed of spruce deals and battens, while the Cronstadt and Archangel are largely composed of Scots fir, or redwood. Swedish timber has never been able to compete with Russian in respect of quality, and for all high-class joiner work architects demand that Archangel or St Petersburg redwood be used. The extent of the Russian forests is not known; and with regard to the prospects of their supplies being maintained, there is at present no question, nor will be for generations to come, in the ordinary course of events. A notable change has taken place during the past few years in connection with Russian oak, which forms a rather important item in the exports. Formerly Riga, on the Baltic, was the chief port of shipment, the oak being brought from the forests some hundreds of miles to the southward; but now the largest proportion of the oak grown within the same regions as formerly is conveyed southwards, and is shipped at Fiume, in Austria. The oak shipped at that port has acquired a high reputation for cabinet and furniture work.

The German imports are comparatively small, and are largely made up of pit-wood and rough timber. Germany can scarcely be considered a great timber exporting country, being largely indebted to Sweden for her own supplies. France sends us, particularly to the British Channel, immense quantities of pit-wood, but her home supplies of heavy timber are quite inadequate to meet her wants. France imports, from Sweden and other countries, several millions of loads to meet home wants.

The supplies of timber from British North America, chiefly from Canada, amounting to 1,366,571 loads, although only half of the Swedish, represents quite as much money value. The chief item is the American pine timber, a substitute for which has not been found in European countries. The maintenance of supplies from this source must be adversely contrasted with Sweden. Writers on forestry have deplored the waste in the American forests, and it is generally admitted that it is prodigious. At the same time, the vastness of the forest areas have maintained the equilibrium of the trade. While most kinds of timber have been, through competition, kept to the lowest value, pine timber from Canada has not only maintained its price, but has actually experienced a steady rise. Consumption, or extra demand, has not caused this, but it arises from the fact of the demolition of the forests within reasonable distance of the seaboard. There is a growing tendency to import manufactured Canadian pine, and the figures of same, compared with hewn, may be quoted,—the 1,366,571 loads being made up of 180,966 loads of hewn, and 1,185,605 loads of sawn and manufactured timber. There is less to be said against the growth of Canadian manufactured imports than that of Sweden, as the freight saved on deals and battens over logs is very considerable, the rate from Sweden being only about 8s. per load, while from America it is about 24s.

The vast forests of immense trees in British Columbia have recently been drawn upon for introduction into this country as a substitute for yellow pine, but so far the experiment has proved unsatisfactory. The timber can be got larger and cleaner, but it lacks that mild nature which is characteristic of the Canadian pine. It is found difficult to sustain a polish, and is too strong in the reed for fine household or ship work. The supplies in British Columbia are practically unlimited, and for rough work, in beams, etc., might adapt itself, but the distance from our shores quite handicaps it in competition with other woods used for similar purposes.

Pitch pine timber has taken a most important place in our industries. The supplies available are immense, and there is every probability that they will be maintained. The cheapness of this wood has popularised its use, notwithstanding the fact that the cost of freight is about 35s. per load. It is sold here at something like 50s. per load, which, with insurance and other charges, cannot leave more than 10s. per load at port of shipment. It is cut down, sawn, and transported a long distance for this sum, which gives us some indication of what could be done were our foresters at home to exercise their ingenuity on the question of transport from the woods.

Kauri timber from New Zealand now receives much favour. It is, however, classed as a fancy wood, and is only utilised for cabinet purposes, so it can scarcely be included in an article on common timber. New Zealand is too far away to draw upon for ordinary carpenter's timber, which really forms 80 per cent. of our imports.

A class of wood that is becoming popular is "Whitewood," called also "Canary wood" or "Butternut." It is taking the place of the long familiar yellow pine, and the price being somewhat less, it is being generally used. The beautiful clean grain, free from knots and shakes, and the great width it is capable of producing, have acquired it a favour in most industries. It is imported from both Canada and the United States. The supply of it is said to be more limited than that of the yellow pine, but statistics of the forests and their timber are not available for any practical purposes.

The total imports to Scotland in 1891 amounted to 878,924 loads. One-fourth of this was American timber, consisting of yellow pine, pitch pine, hardwoods, and spruce; two-thirds Baltic and north of Europe, Scots fir, and spruce; and the remainder made up of sundries—teak, kauri, and other special woods.

Before concluding, it may be interesting to take notice of an experiment being made at the present time by the Swedish shippers. Considering their British business practically established, the shippers conferred together and agreed to bind themselves to place their credit on nearly the same footing as their Russian neighbours. The effect of this action has not yet become fully apparent, but although these terms have only been in operation a few months, the decline of Swedish sales has been so marked that considerations for the abolition of this rule are already exercising them. We have referred to this part of the subject with the view of showing how much more influence than the actual merits or demerits in price, a hidden cause may exert on the development of a given industry. The question is a common one,—Why will foreigners, removed from our shores by hundreds of miles and frequently by thousands, entrust our merchants with six months credit, while our own foresters, agents, and landlords will not trust them a day, although the timber is retained in their own hands? Forestry in this country has little interest for the mercantile community, but the foreigner gives us a substantial interest in the subject, and we in return reciprocate the benefit by obtaining our supplies of timber from abroad.

XXVII. *Machine for Mending Broken Strands in Wire Fences.* Invented by ANTHONY SIMPSON, Forester, Dunrobin Castle, Golspie.

Where wire fences are extensively employed, a machine for mending the broken strands is very desirable. No doubt the "ratchet" straining-posts are now in frequent use, but they are by no means predominant, and being a recent invention, the fences erected before their advent require attention occasionally, if not frequently; and often a "ratchet" straining-post may not be in keeping with the surroundings.

I have fully tested this machine, and found it to be a marked improvement on any others that I have either used, seen, or heard of. By the use of it a great amount of time, labour, and expense is saved, and I can thoroughly recommend it to all foresters and others employed in the erection and repair of wire fences.

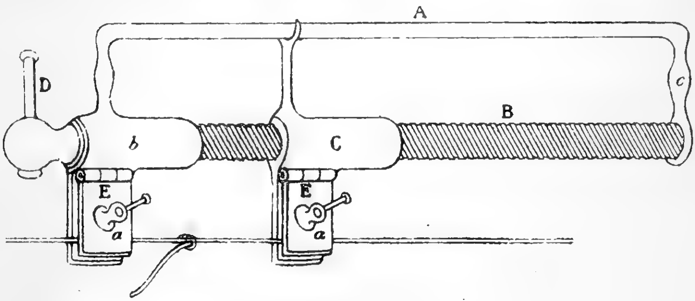
The merits of my invention are—

(1) It is a more expeditious way of mending broken strands in wire fences than any method hitherto known and practised.

(2) It is so constructed that it can be applied to strain the wire at the point where it is broken, so that it can be easily tied there again.

(3) It can also be used at the straining-posts in the erection of wire fences as an ordinary straining machine.

The following illustration shows the various parts of the machine, and the method of working.



EXPLANATION.

A. Frame; with (*b*) headstock, and (*c*) bracket.
B. Screwed spindle, revolving in the headstock and bracket.
C. Travelling screwed socket.
D. Lever for working the main screw.
EE. Hinged clips, with (*aa*) lever screws.

In operating with the machine, run out the travelling socket to the end of the screw; place the ends of the broken wire in the clips and secure them tightly by the screws *aa*, so that they will not slip in the straining; work the main screw by the lever D till the ends of the wire overlap sufficiently to form a proper knot, which is made in the usual manner; then unscrew the clips, and the job is finished.

Royal Scottish Arboricultural Society.

EXCURSION

TO

FIFESHIRE AND PERTHSHIRE.

1892.

ROYAL

SCOTTISH ARBORICULTURAL SOCIETY.

EXCURSION TO FIFESHIRE AND PERTHSHIRE.

The Fifteenth Annual Excursion of the Society was held on the 10th, 11th, and 12th of August, when the estates of Stravithie, Balbirnie, and Falkland, in Fifeshire; and Scone, Meikleour, Murthly, Methven, The Cairnies, and Balgowan, in Perthshire, were visited. For the occasion, the headquarters of the Society were at the Salutation Hotel, Perth.

Easy of access by rail from all parts of the country—north and south—it was expected that an Excursion to this district, so full of interest to the arboriculturist, would be exceedingly popular with the members. So it turned out to be. A better attended Excursion has not been held in the history of the Society. The weather on the three days left little to be desired by those who had to pass the most of their time in the open air, and, on the second day, *éclat* was given to the proceedings by the presence of a party of members of the British Association, who, having completed the business of the meeting at Edinburgh of the Association, made an excursion north to see the beauties of Scone and Murthly in company with the members of the Arboricultural Society. Among other gentlemen taking part in the Excursion were:—Charles Adamson, Leven; John Alexander, Kandy, Ceylon; John Allan, Dalmeny; Professor Bayley Balfour, *President* of the Society; John Barron, Borrowash, Derby; J. Barton, Hatfield, Herts; R. Baxter, Dalkeith; Lewis Bayne, Scone; James Berry, Berwick; W. S. Bissett, Bridge of Earn; Andrew Boa, Dalton, Newcastle; A. Boa, jun., Great Thurlow, Suffolk; John Boyd, Pollok, Pollokshaws; Charles Buchanan, Penicuik; J. Clark, Haddo House, Aberdeen; Dr Cleghorn, Stravithie; Philip Cockburn, Dalkeith; James Cook, Arniston, Gorebridge; James Crabbe, Glamis; George Croucher, Ochtertyre, Crieff; John

Cunningham, Ardross, Alness; James Dalziel, Maybole; John Davidson, Auldbar, Brechin; J. W. Deas, Edinburgh; A. S. Donald, Philiphaugh, Selkirk; Robert Douglas, Edinburgh; P. Drummond, Stirling; J. W. Duncan, Broughty Ferry; Malcolm Dunn, Dalkeith; William Erskine, Edinburgh; A. J. Farquharson, Newtyle, Forfarshire; John Fleming, Aberdeen; Robert Forbes, Clova, Aberdeenshire; F. Foreman, Eskbank, Dalkeith; James Forgan, Sunnybraes, Largo; Thomas Foulis, Edinburgh; J. Galletly, Bonhard, Perth; W. M. Gilbert, Edinburgh; William Gilchrist, Leuchars, Elgin; John Gilroy, Berwick; C. S. Goodchild, Suffolk; John G. Gordon, Edinburgh; G. H. Gorrie, Dalkeith; J. A. Gossip, Inverness; James Granger, Penicuik; A. A. Green, Edinburgh; Professor Green, Cambridge; Archibald Henderson, Tullamore, King's County, Ireland; William Henderson, Balbirnie; Daniel Irvine, Perth; James Jones, Larbert; James Kay, Rothesay; John Kerr, Gorebridge; R. G. Kerr, Musselburgh; D. P. Laird, Edinburgh; James Laurie, Murthly; Peter M'Farlane, Perth; D. M'Gregor, Camperdown, Dundee; Major M'Gregor, Penicuik; D. F. M'Kenzie, Morton Hall, Liberton; Rev. Mr M'Kerchar; A. M'Kinnon, Scone, Perth; George M'Kinnon, Melville, Lasswade; J. T. M'Laren, Alloa; Alexander M'Rae, Leven; J. M'Rorie, Cowdenbeath; John Methven, Edinburgh; John Methven, Blythswood, Renfrewshire; John Michie, Balmoral; A. Milne, Edinburgh; R. P. Milne, Berwick-on-Tweed; William Milne, Berwick-on-Tweed; James Mitchell, Fossaway; James Moffat, Edinburgh; William J. Moffat, *Secretary* of the Society; G. Morgan, Crieff; Malcolm Morgan, Crieff; J. Murdoch, Dalkeith; Colin M. Patterson, Newbattle; Thomas Patterson, Eskside House, Dalkeith; W. A. Rae, Kingswood, Murthly; William Rayson, Chelsea, London; James Robertson, Panmure, Carnoustie; William Robertson, Murthly, Perth; James Romanes, Meadowbank, Dalkeith; James Rutherford, Redcar, Yorkshire; D. Scott, Darnaway, Forres; Andrew Slater, Haystoun, Peebles; William Smith, Edinburgh; Professor Somerville, Newcastle; R. Storie, Dalkeith; James Tait, Penicuik; M. Temple, Carron House, Falkirk; Hon. Waldegrave-Leslie; James Watt, Carlisle; James Welsh, Edinburgh; Peter Whitton, Methven, Perth; A. T. Williamson, Edinburgh; G. Williamson, Leven; and J. J. Wilson, Penicuik.

FIRST DAY.

Wednesday, 10th August.

STRAVITHIE, BALBIRNIE, LESLIE, AND FALKLAND PALACE, FIFE.

An early start had to be made this morning by the party from Edinburgh, which left the Waverley Station at 6.35 A.M., by train for Stravithie Station. About sixty gentlemen assembled on the platform wearing the Scots Fir badge of the Society, and there were several additions made to that number *en route*.

Leaving Edinburgh behind, the journey was through one of the richest agricultural districts in the Lothians, and at this season of the year the crops were at their best, giving promise of a bountiful harvest. About ten miles from Edinburgh, the "Queen's Ferry" was reached, and the gigantic structure of the Forth Bridge, spanning the estuary with cyclopean strides, was crossed at a height of nearly 200 feet. The views from the Bridge on such a fine day, both up and down the Forth, are probably unrivalled in railway travelling, and to arborists both shores of the Firth presented a very interesting sight, being in great part richly clothed with woodlands to the water's edge. Immediately below the Bridge on the Lothian shore lie the woods of Dalmeny; and above the Bridge on the same side are the wooded slopes of Hopetoun, stretching back a considerable distance into the country.

On the opposite Fife shore above the Bridge are the well-wooded domains of Broomhall, Torry, and Valleyfield running far up the country; while below the Bridge, on the north side of the Firth, are the fine picturesque woods of Donibristle and Aberdour. Passing North Queensferry and the ancient burgh of Inverkeithing, the line sweeps to the right through pleasant fields and hedgerows thickly studded with trees, with the domain of Donibristle on the right, and Fordell, Otterstone, and Cockairne, on the left, all famed among arborists for their fine trees, and the scene of one of the earliest excursions of the Society. The shore of the Firth is again reached at the prettily situated village of Aberdour, a favourite watering-place of the Edinburgh folk, and celebrated in the ancient ballad of *Sir Patrick Spens*, which tells that on returning from Norway, where he had conveyed the Princess Margaret of Scotland to be married to King Eric,—

> "Half owre, half owre to Aberdour
> It's fifty fathoms deep;
> And there lies the good Sir Patrick Spens,
> Wi' the Scots lords at his feet."

On the right, after passing the railway station, a glimpse is had of the extensive remains of Aberdour Castle, a stronghold and residence of the Earls of Morton since 1351, but which was accidentally burned about 160 years ago, and has since lain in ruins. From here the line runs close to the north shore of the Firth of Forth, past Burntisland, Kinghorn, and Kirkcaldy, and all the way the sea views on a fine day are very beautiful. The views inland are generally limited, but the low hillsides are noticed to be well clothed with woods. At the foot of a rocky height close to the left of the line about a mile beyond Burntisland, a monument, erected a few years ago, marks the spot where King Alexander III. was killed, on the 12th March 1286, by falling over the precipice while riding to Kinghorn Tower in the dusk of the evening. On nearing Kirkcaldy, the richly-wooded policies of Raith are observed on the left, with the elegant mansion-house standing on a fine site peeping out from among the trees. Leaving the busy manufacturing town of Kirkcaldy, where the leading article of trade, floorcloth, scents the air, and passing the thriving towns of Dysart and Sinclairtown, we leave the main line at Thornton Junction, and the journey for the rest of the way to Stravithie is along the East of Fife Railway. About three miles from Thornton the famed Cameron Bridge distillery is passed, standing close to the line soon after it enters the pretty valley of the Leven, down which the route lies to the town of Leven at the mouth of the river. Keeping the fine golfing links on the right, the railway sweeps north and eastwards round Largo Bay, celebrated in the fisherman's song, *The Boatie Rows*—

"I cuist my line in Largo Bay,
And fishes I caught nine;
There's three to boil, and three to fry,
And three to bait the line."

The village of Lower Largo, lying along the shore, was the birthplace, in 1676, of Alexander Selkirk, the original of Defoe's *Robinson Crusoe;* and within the grounds of Largo House, situated in a well-wooded park on the rising ground on the left, are the remains of Largo Castle, the residence in the end of the fifteenth century of the famed sea warrior, Sir Andrew Wood of Largo. Nearing Elie, a favourite water-place, lying close to the sea shore on the right, the policies of Elie House are seen alongside of the line, and the route is through a well-cultivated country, past the fishing village of St Monans, with its curious ancient church, said to have been founded about 1362 by David II., and the thriving town of Anstruther, the native place of Tennant the poet, and the scene of his

Anster Fair, in which he so graphically describes the feats of the heroine "Maggie Lauder," till the "East Neuk o' Fife" is reached at the ancient and picturesque royal burgh of Crail. The route now bends sharp to the westward, and runs through a highly cultivated district, past the stations of Kingsbarns and Boarhills, on to Stravithie, which was reached about ten o'clock. Here Dr Cleghorn was in waiting to receive the party, and gave them a most hospitable welcome. Let us pause to say a word about this most genial of ex-presidents of the Society, and of his beautiful little estate.

Stravithie is situated about five miles from the venerable city of St Andrews, and is the ancestral home of Hugh F. C. Cleghorn, M.D., LL.D., F.R.S.E., F.L.S., one of the best known and most popular of foresters that Scotland has ever produced. For many years at the head of forestry affairs in India, he has, since his return home about twenty years ago, taken the keenest interest in Scottish forestry, and promoted every movement to advance the education and practical training of foresters. A member of the Royal Scottish Arboricultural Society since 1865, he has filled the office of President for five terms, first in 1872 and 1873, and again from 1883 to 1885, during which latter period the Forestry Exhibition was held at Edinburgh, when he took a prominent part in carrying out the scheme, and was the moving spirit of its success. For these and other reasons Scottish foresters owe a debt of gratitude to Dr Cleghorn, and the visit of the Arboricultural Society to Stravithie may fitly be called their pilgrimage to the forester's Mecca. Dr Cleghorn takes great personal interest in all the affairs of his estate, and is his own forester in arranging and managing his plantations. These are well placed for sheltering and ornamenting the estate, which extends to upwards of a thousand acres, divided into several well-cultivated farms, occupied by prosperous tenants. In a rather high-lying and naturally bare district, shelter was an important point in the formation of the plantations, but still they have been laid out with the view of also obtaining a fair return for the land they occupy; and Dr Cleghorn has carried out several experiments as to the best methods of planting, so as to combine shelter, ornament, and profit. The oldest trees, chiefly hardwoods, are growing in the policies around the mansion, and along the prettily wooded glen through which flows the limpid Kenly burn.

Taking carriage at Stravithie Station, the party drove through a bit of nice open country, with waving grain on each side of the road, and along a shady avenue to Stravithie House, which is perched on the side of a bosky dell, with rose-covered walls and *entourage* of beautiful pines, whose colours on this sunny morning told well against the foliage of the older beeches which fill up the valley. In a marquee erected on the lawn the company were hospitably entertained to an elegant *déjeuner*. The table was resplendent with flowers, and on it were also the fruits of the season. To the breakfast, it is needless to say, the party, after their long railway journey, did every justice. The doctor himself presided, and by his great kindness and cordiality made every one feel perfectly at home.

Mr JOHN METHVEN, one of the Vice-Presidents of the Society, gave expression to the sentiments of the company in a few well-chosen sentences. We cannot, he said, rise from the table without thanking Dr Cleghorn for his magnificent hospitality, of which we have been the recipients this morning. We hold Dr Cleghorn in the highest admiration. He is the "Grand Old Forester." To-day he has laid one more obligation upon us all, in addition to the many good offices he has performed for the Royal Scottish Arboricultural Society. We know by repute what Dr Cleghorn did for forestry in India; our own eyes have seen what he has done for forestry in Scotland; and we love and revere the man for his own sake, and honour and admire him for his works. Let us thank him most heartily.

(As a souvenir of the visit, Mr Methven then handed to Dr Cleghorn an oak walking-stick, which combined with it an ingenious steel band-saw arrangement. The presentation was of an impromptu kind, the patent saw-stick having only been brought to the notice of the Society on the previous evening by the Hon. Waldegrave-Leslie. It was on account of its novel ingenuity, and not on account of its intrinsic value, that a suggestion was promptly acceded to, that a specimen should be presented to Dr Cleghorn.)

Dr CLEGHORN, in rising to reply, was received with loud applause. At the outset he intimated letters of apology from Professor Bayley Balfour, *President* of the Society; Professor M'Intosh, St Andrews; Colonel Bailey, Lecturer on Forestry in Edinburgh University; and his nephew, Major Sprot of the Carabineers—all of whom regretted their inability to be present. It is six years, the doctor continued, since this visit of the Arboricultural Society was talked of. At my time of life that is a long period, and I was beginning to think I was not to see the Society at Stravithie; but now that you are here, I rejoice greatly. I am only sorry you cannot remain longer with me, for I understand you have to leave by train almost immediately. But I thank you very much for coming here. I consider it very kind of you to pay me this visit, and once more I bid you all a cordial welcome. I thank Mr Methven for his too kind words, and for the way you have received them. I am also obliged to you for this useful present, which I shall keep as a memento of your visit.

An adjournment was then made to the policies, and on a sunny slope near the mansion there was planted, in commemoration of the visit of the Society to Stravithie, a fine example of the Golden Retinospora, or Cypress, of Japan, *Retinospora pisifera aurea*, which was presented to the Society by Mr Alexander Milne, of Messrs Dickson & Sons, Inverleith Nurseries, Edinburgh. The sapling was well and truly planted, each member of the Council carefully placing a good spadeful of the rich loamy soil around its roots till the hillock was neatly finished, and then the best wishes of the party for its future welfare were cordially expressed.

Under the guidance of the doctor, the party then had what was little more than a scamper through the well-kept grounds and garden, which, as already hinted, are charmingly situated in the dell of the Kenly burn. The grounds contain many fine beeches, which is the tree *par excellence* of the East Neuk; and a representative collection of the newer Conifers, most of which thrive well here when sheltered from the bitter north-eastern blast, which, blowing in from the North Sea in the spring months, is the greatest evil that trees have to contend with in this district of Fife. On the sunny slopes of the lawn and along the sheltered glen are many nice specimens of Conifers, all of which have been planted since 1864, when Dr Cleghorn succeeded to his paternal estate. Among them are a number of specimens of Indian Conifers, raised from seeds which Dr Cleghorn brought home from their natural habitats in Northern India, and on the Himalaya Mountains, in 1864 and 1870; and in about a quarter of a century they have grown into graceful young trees. The doctor is naturally proud of them, as they vividly recall many pleasant incidents of Eastern life and travel, amidst which some of the best years of his life were spent. The gracefully drooping Deodar, or Indian Cedar, and the equally beautiful if rather tender *Pinus excelsa*, are both good specimens at their age; and there are also nice plants of *Cupressus torulosa*, *Abies Webbiana*, *A. Pindrow*, and *A. Morinda*—the latter, however, being very liable to be nipped by the cold east wind in spring,—all of which have been raised from seeds brought home by Dr Cleghorn. Of other Conifers there are fine examples of the Douglas fir, Menzies' spruce, Spanish fir, Lawson's cypress, the Swiss stone pine, *Thuja gigantea*, *Thujopsis borealis*, *Wellingtonia gigantea*, and others. A fine young specimen of the maidenhair tree, *Salisburia adiantifolia*, after attaining a height of about 20 feet in fourteen years, succumbed to the severe frost of the winter in 1880-81. An interesting plant is a young walnut tree, planted by the Edinburgh Botanical Club to commemorate their visit to Stravithie in 1890. The policies are well furnished with an underwood of hollies, laurels, rhododendrons, yews, etc.; and most of the common forest trees, besides the beech already noted, thrive well. Many fine trees of the Wych elm, ash, oak, Scots fir, larch, etc., are met with in the plantations, which extend to about seventy acres, and lie at an average of 300 feet above sea-level, about three miles inland, and fully exposed to the north and east. The soil is of medium quality, rather cold and in places retentive, and rests on the Carboniferous formation of the east of Fife.

For the measurements of the most of the fine trees in the following table we were indebted to Dr Cleghorn. The table gives a good idea of the growth of trees under able management in an exposed district, by no means favourable to tree life.

Trees at Stravithie.

Botanical Name.	Age.	Height.	Girth at 5 ft. up.	Exposure.	Remarks.
	years.	feet.	ft. ins.		
Abies Douglasii, . .	23	40	3 10	sheltered	Thrives well in shelter.
,, *nobilis*, . .	25	32	2 7	,,	Beautiful tree; has fruited freely.
,, *pectinata*, . .	...	105	7 9	,,	A very fine silver fir.
,, *Pinsapo*, . .	...	10	2 0	,,	Bushy — suffered from frost.
,, *Webbiana*, . .	20	28	2 1	,,	Beautiful thriving tree.
Araucaria imbricata, .	22	32	2 1	,,	Much nipped by east winds.
Cedrus Deodara, . .	20	18	2 0	N.	Grown from seed from Simla, 1864.
Cupressus Lawsoniana,	25	25	2 8	S.	Growing luxuriantly.
Fagus sylvatica, . .	...	95	7 2	In Glen	Fine clean stem; healthy.
,, ,, . .	...	65	7 8	,,	,, ,, ,,
,, ,, . .	...	62	7 4	,,	,, ,, ,,
Fraxinus excelsa, . .	...	55	6 9	S.	Thrives well.
Juglans regia, . .	...	2½	...	S.	Planted by Edinburgh Botanical Club, 1890.
Larix europæa, . .	70	95	5 10	S.	Heavy crop of cones.
,, ,, . .	50	84	5 4	S.	Fine old tree.
,, ,, . .	50	96	5 2	S.	,, ,,
Libocedrus decurrens, .	25	25	2 10	S.	Handsome tree.
Pinus Cembra, . .	...	22	2 4	sheltered	Very fine specimen.
,, *excelsa*, . .	28	35	2 11	,,	Grown from seed from Simla, 1864.
Quercus robur, . .	...	75	5 9	S	Mentioned in Jeffrey's *Trees of Fife*.
,, ,, . .	...	92	5 6	S.	In the Glen; fine.
Thuja gigantea, . .	25	40	2 6	S.	Fine free-growing tree.
Ulmus montana, . .	...	70	7 4	In Glen	Thrives well in the district.
Wellingtonia gigantea,	25	44	3 9	S.	Does well in shelter.

BALBIRNIE.

Returning by the same route to Thornton, it was expected that Markinch would be reached about one o'clock; but the railway journey was tedious, and it was nearly two o'clock before the party arrived at their destination. The neighbourhood is rich in historical incidents. It comprises many ancient seats of old Scottish families—Balfours, Beatouns (now Bethune), Leslies, Lindsays, Melvilles, and others of renown in Scottish annals—but few of them can be seen from the route, and none were visited except the modern home of the Balfours of Balbirnie, for which the party was bound.

The drive from the station through the small country town of Markinch was about half a mile, when the extensive and beautiful policies of Balbirnie, the seat of Mr John Balfour of Balbirnie, were entered, through the sylvan glades of which the company were led for the next two or three hours, to see the principal features of interest to arborists, and to admire the fine trees and rich sylvan landscape. The mansion is a handsome edifice, standing in a romantic spot, richly embosomed among stately trees, and surrounded by beautiful gardens and well-kept grounds of considerable extent. During the long possession of the present highly esteemed proprietor, great improvements have been carried out on all parts of the estate, which is now among the best organised, as it is the largest in acreage, in the county of Fife.

The company were most cordially received in front of the mansion by Colonel and Mrs Balfour, Mr Edward Balfour, younger of Balbirnie, and other members of the family, and immediately proceeded on a tour through the grounds and park under the guidance of Mr Edward Balfour. A large number of very fine trees were seen. In a grand old beech avenue one of the trees girthed 10 feet 9 inches at 5 feet up, and had 25 feet of a clean bole, with many others closely approaching it in size. A walk along a charming burnside, where a dark-leaved boxwood formed a fine feature in the underwood, was much enjoyed; and not less enchanting was the sight of the beautifully undulating and well-wooded park, the trees being chiefly beeches with fine wide-spreading heads. A grand birch, standing a little to the south of the mansion-house, attracted much notice. At about 9 feet up it spread out its branches like a candelabra, the arms being of great thickness, and presented a very curious and picturesque appearance.

On returning to the pleasure-grounds, the company were hospitably entertained to luncheon, which was served in a large marquee specially erected for the occasion, on the beautiful greensward of the lawn near the mansion. Mr Edward Balfour presided, and, when the repast was finished,

Mr John Methven asked the company to drink to the health of Colonel Balfour, who had been so kind as to invite the Arboricultural Society to visit his beautiful demesne, and had so hospitably received them. Balbirnie was one of the first places he had any distinct recollection of. When he was a boy he had seen it frequently. He had often visited it since, and he could truly say that Balbirnie had always been kept up as the estate of a Scottish gentleman ought to be, and he was certain that would be the opinion of them all after they had seen its beauties. They most heartily congratulated Colonel Balfour on keeping his years so well, and they would ask the chairman to convey to his father their obligations to him for his kindness to the Society.

Mr Edward Balfour, younger of Balbirnie, who was received with loud applause, said his father, who was not able to be present, had asked him to thank them for the honour they had done him in coming to look at his property. Colonel Balfour had been resident on this place for fifty-five years, and in their walk round the estate they would see traces of his hand in everything connected with it. They did not think of their home here perhaps in the same way as Mr Methven had spoken of it; at the same time they did not consider they had anything to be ashamed of in having Balbirnie as a show-place to-day. He was afraid they would only see some of what he might call the ornamental woods. The commercial timber was too far away for them to inspect in the limited time which he understood was at their disposal. On their way to Falkland, however, they would see a part of these woods in the distance as they drove along the highway.

Dr Somerville proposed the health of Mr Edward Balfour, who had so ably presided over the luncheon, and for his kindness in acting as their guide over the estate.

Mr Edward Balfour, in reply, said that he should like to come with the Society next year, if they would honour him with an invitation.

After luncheon, two hours were spent pleasantly and profitably in inspecting the trees in the policies and pleasure-grounds. Many splendid old beech trees were met with, as also excellent oaks and larches, and fine specimens of other deciduous trees. A number of the trees were measured. The largest beech was 15 feet 10 inches in girth at 5 feet up. A very fine oak was 9 feet 9 inches in circumference. A tall sycamore, with a shapely head, was 11 feet 6 inches in girth; and another tree of the same kind at the back of the gardens, girthed 13 feet at 4 feet up. A larch tree, girthing 9 feet 4 inches, was about 100 feet in height; and a Scots fir 90 feet high girthed 9 feet. In The Dell there was a good display of the newer conifers, interspersed with hardwoods, and much admiration was expressed at the judicious use which had been made of the red and white foxglove in the adornment of this lovely spot. Among the newer Conifers here were a number of beautiful Albert firs, one of which was 45 feet high, and girthed 3 feet 1½ inch at 5 feet up. *Abies grandis* and the Douglas fir were growing freely, and promising to make very fine trees. One of the remarkable things in The Dell is a magnificent specimen of *Rhododendron catawbiense.* Rising from the ground in a single stem, it almost immediately parts into two, each about 2 feet 8 inches in girth. From these there has grown out a spread of branches no less than 152 feet in circumference, with a height of 16 feet. After a pleasant ramble through the fine old wood growing on the height to the south of The Dell, where numerous tall and shapely trees, chiefly beech, were noted, the ground beneath being well furnished with thriving shrubs, principally rhododendrons, we arrived at the gardens, near which is the pinetum, with many fine specimens of the newer Coniferæ, including a fine row of *Araucaria imbricata,* averaging over 30 feet in height and 4 feet in girth at 5 feet up. Among the finest of the conifers were the following specimens, for the dimensions of which we were indebted to Mr Henderson, the gardener at Balbirnie:—

CONIFERS AT BALBIRNIE.

Botanical Name.	Height.	Girth at 5 feet up.	
	feet.	ft.	ins.
Abies Albertiana, ...	43	4	0
,, *grandis,*	60	4	9
,, *Morinda,*	33	3	4
,, *nobilis,*	46	6	0
,, *Nordmanniana,* . .	36	3	0
,, *orientalis,*	32	4	8
Cedrus atlantica, ...	34	4	7
,, *Deodara,*	39	5	0
,, *Libani,*	50	5	7
Cupressus Lawsoniana, . .	28	1	6
Pinus Cembra, ...	36	3	9
Taxodium sempervirens, .	40	7	0

Some splendid specimens of golden hollies were also seen, about 50 feet high, with a stem girthing 4 feet 11 inches at

5 feet up in one that was measured, all being well-furnished and brightly coloured trees. A rapid run was made through the beautiful gardens, hothouses, and conservatories, which were all seen in perfect order. The gardens, grounds, and policies through which we had been led, gave evidence everywhere of a most enlightened and liberal management.

In returning towards the mansion, the company were much interested in a small military tent erected on the ground, which had belonged to the grandfather of the present proprietor, who commanded the Scots Greys at Waterloo. Alongside of it was an officer's tent of the present day, which illustrated the advance made in the comfortable housing of the officers of the British army on the "tented field" since the days of Waterloo. At the mansion the party had the privilege of inspecting the pictorial treasures which adorn the walls of the spacious public rooms; and among them was a lovely full-length portrait of Mrs Edward Balfour, which was greatly admired. They also saw there the original charter of the lands of Balbirnie to the present family, dating from 1234 A.D.—over six centuries ago.

A photograph was taken by Mr Philip Cockburn, the Society's photographer, in front of the house, of the whole of the numerous company, which included Colonel and Mrs Balfour, Mr and Mrs E. Balfour, and other members of the Balbirnie family. Thanks were again accorded to Colonel and Mrs Balfour, and Mr E. Balfour, for their great kindness and courtesy during the afternoon, and a hearty cheer for the family was raised as the carriages drove off.

LESLIE.

A very courteous invitation was given to the Society by Mr Waldegrave-Leslie to visit his estate, about two miles distant, when leaving Balbirnie, but for want of time this could not be accepted. The following notes, however, of Leslie will be read with interest.

Marching with the parish of Markinch is that of Leslie, where is located the property of the ancient family of Rothes. The late countess (sixteenth in the succession) died rather more than six years ago, much lamented by all ranks of society. Her sweetness of character, generosity, and beneficence will not readily be forgotten by those who had the privilege of her acquaintance. The property is now in the hands of the Hon. George Waldegrave-Leslie, LL.D., as liferenter; and under his management the estate bears quite a different aspect to what it did some thirty years ago. Nearly every farm-house, cottage, and farm-steading has been put into thoroughly good condition, and in many cases entirely rebuilt. At the new and commodious farm-steading of Cadham, tenanted by Mr David Russell, partner in the firm of Robert Tullis & Co., papermakers (whose extensive mills lie below in the valley of the Leven), there is an avenue of young plane trees, planted on each side of the public road leading to the town of Leslie. Beyond this is a lodge, painted Indian red, made of strong planks of timber driven vertically into the ground 9 inches apart, and sheeted up on each side with 1½ inch deals, between which flax refuse is tightly packed. This makes a very comfortable tenement, warm in winter, and cool in summer. A set of hand-wrought iron gates from Falkland Palace, famous for having confined the redoubtable Rob Roy in one of his cattle-lifting expeditions, open on a new road leading to Leslie House. On the east side is a thriving plantation of Scots pine and rhododendrons, sheltering it from the east wind. The road is over a mile in length, and for the first half it is planted on each side with lime trees and Weymouth and Scots pines alternately. The river Leven runs for about two miles through the policies, and is seen in the bottom of the valley, till the road enters Queen Mary's famous beech avenue. The trees in the avenue stood well until the destructive "Royal Charter Gale" of 1859, when many of the noblest fell, blown down by the violence of the storm. The gaps have been filled up with oaks—the oak being the badge of the Leslie clan. This avenue now forms an approach to the east front of Leslie House, towards which a turreted bridge of substantial masonry carries it across the Lothie Burn, at a beautiful spot, well known in the locality as "The meeting of the waters." Leslie House was built by the Duke of Rothes, when Lord Chancellor of Scotland, after the same design, quadrangle and all, as Holyrood House, and by the same architect, Sir John Bruce of Kinross. In the year 1759 three sides of it were burnt to the ground, including a gallery 17 feet longer than that of Holyrood, and containing the second best library in Scotland. The remaining, or fourth side of the quadrangle now constitutes Leslie House—and is yet far too large for the size of the estate, two-thirds of which were sold to pay the cost of the extravagant funeral of the Duke of Rothes. This funeral was ordered by King Charles II., and is said to have cost over £266,000, a sum equivalent to something like two millions sterling. The funeral procession is said to have been 15 miles in length. The procession walked from the palace of Holyrood to Queensferry, and thence to Leslie Kirkyard, where His grace's remains now lie in the aisle of the Rothes family.

On the south side of Leslie House are a series of terrace gardens leading down to the Leven. At the end of the upper terrace is a remarkably fine beech tree, which girths nearly 17 feet. A winding road leads down to the river and up the other side of the valley to the Duchess Gate. Looking from there to the north, the East Lomond Hill is seen to great advantage; and looking round from this coign of vantage towards the south-east, a deep gorge lies immediately below, well planted with trees, with a glorious view of the sea some miles off, and also the Bass Rock, North Berwick Law, and Tantallon Castle, all of which are clearly seen on a fine day.

On Leslie green stands the parish church, said to be King James V. "Christ's Kirk on the Green," also a remarkable stone called the "Bull Stane," so named from the fact that bulls were chained to it, for the semi-barbarian pastime of baiting. Two famous trees also stand on the green; one, an oak, under which King James V. is said to have sat and dealt out justice to his lieges; and another, the "Dieul" tree, a sycamore, from the boughs of which culprits were hung for crimes worthy of death.

In the gardens at Leslie House are several very fine coniferous trees, from twenty to thirty years of age, among which is an *Abies Albertiana*, supposed to be one of the finest of its kind in Scotland.

FALKLAND.

Towards five o'clock the carriages left Balbirnie for Falkland Palace, the seat of the Marquis of Bute. The road traversed a pleasant and level country, a part of the "Howe o' Fife," and at about four miles from Balbirnie, the picturesque old burgh of Falkland, in the centre of which the old palace stands, was reached. Here there was only time to make a limited inspection of the rich sylvan wealth and beauties of this ancient hunting-seat of the Scottish Court. The palace, begun, it is said, by James III., was finished in 1537 by James V., who, after his defeat at Solway Moss, returned here to die on the 13th December 1542. His daughter, Mary Queen of Scots—of whose birth at Linlithgow he heard shortly before he expired, and exclaimed, "It came with a lass, and it will go with a lass," referring to the royal titles—often resided within its stately walls. It suffered long from decay after being deserted by royalty:—

> "The fretted roof looked dark and cold,
>   And tottered all around;
> The carved work of ages old
>   Dropped wither'd on the ground;
> The casement's antique tracery
>   Was eaten by the dew;
> And the night breeze, whistling mournfully,
>   Crept keen and coldly through."

But its remains have of late been carefully preserved, and present many features of interest to the antiquary. The modern house, which is nearly a mile distant, was erected about fifty years ago, from designs by the architect Burn of Edinburgh. It is a handsome building in the Tudor style, and the grounds and gardens around it are laid out with much taste and skill.

The old palace, which is at present being put into order by the Marquis of Bute, was examined with much interest, both externally and internally. It is classic ground, and many of the events in Scottish history associated with it were anew recounted as the party paced the ancient halls which royal feet had trodden in days of yore, and peeped into the horrid dungeons where, among others, David Duke of Rothesay, eldest son of King Robert III., was starved to death by his uncle, the then Duke of Albany. Numerous sycamores, a tree so closely associated with the name of Mary Queen of Scots, were found growing upon and near the historic pile. Two of these in the garden, which were measured, were respectively 10 feet 6 inches and 10 feet 4 inches in girth. Major Wood, the Marquis of Bute's factor, kindly provided tea and other refreshments for the company, who afterwards drove through the quaint, old-world "burgh toun," the "Falkland on the Grene" of the muse of James V.:—

> "Was nevir in Scotland hard nor sene
> Sic dansin nor deray,
> Nouthir at Falkland on the Grene,
> Nor Pebillis at the Play"—

to the modern house of Falkland. Amid a wealth of arboreal treasures seen there, perhaps the most remarkable trees were a group of three Deodars and a splendid specimen of the redwood tree, *Sequoia sempervirens*, which was 9 feet in circumference at 5 feet up, and from 65 to 70 feet high. It was generally acknowledged to be one of the best, if not the best, grown tree of this species in the east of Scotland. Some very fine specimens of the cut-leaved alder—a by no means common tree—were growing in the policies; as also fine examples of *Cryptomeria japonica* and *C. elegans*, *Abies Morinda*, and the tulip tree, *Liriodendron tulipfera*. The beauty of the house, the skilful manner in which the policies are laid out, the disposition, variety, and healthy aspect of the trees, and the scrupulously neat aspect of the whole place, were very much admired, and it was with some regret that the party had to hasten their departure from so favoured a spot. Mr M. Dunn, on behalf of the Society, proposed a vote of thanks to the Marquis of Bute for his courtesy in opening the ancient palace and grounds to them, and for his hospitality, all of which the members had greatly appreciated.

The following remarks on the woods and plantations on the Falkland estate have been kindly supplied by the forester, Mr Henry Smith:—"The woodlands on the Falkland estates in Fife are chiefly situated on the northern slopes of the Lomond hills. The plantations in the vicinity of the mansion consist of the usual variety of hardwood trees. The most notable of these are the beautiful avenue of aged limes and the old beeches on the north approach. In the House Park and Mospie Den there are numerous specimens of conifers in a vigorous condition and growing freely. The plantations on the slopes of East Lomond hill are chiefly larch, spruce, and Scots fir, with a mixture of beech, ash, sycamore, oak, and elm in the lower portions. The larch make healthy growth, although much exposed at the highest parts at an altitude of about a thousand feet above sea-level. These woods are very picturesque, and form a beautiful feature in the landscape. The chief portion of the woodlands, however, are towards the west—on the Black and Green Hills, which are extensively planted with excellent larch, Scots fir, and spruce, with a mixture of hardwoods in suitable places. The larch grown in this wood with a northern aspect is of large dimensions, very healthy and sound at the heart, and only shows the slightest symptoms of 'blister.' They excel in quality any larch grown on the low ground on heavier soil. Beyond this plantation is the 'Brax Wood,' composed of Norway spruce, which grows at an altitude of 1114 feet, and surpasses any spruce grown elsewhere on the estate. It is perfectly sound, and constitutes a very heavy crop.

"The common rhododendron, *Rhododendron ponticum*, was introduced about forty years ago on the 'Black Hill,' where, like the larch, it grows vigorously on the light sandy soil, and propagates itself freely from seed, from which a supply of nice plants is obtained for other parts of the estate.

"Another notable portion of the woodlands is the remains of the royal oak forest at Drumdrill, which extends to about 40 acres. The fine oaks are growing vigorously from the stools of the original trees at about 50 feet apart, with oak and hazel as underwood.

"The woods on the Lomonds extend in all to about 600 acres, and are from sixty to seventy years of age, and are all in excellent health. A large portion of the woods on the lower parts of the estate are a mixture of the usual forest trees. The larch makes rapid growth, but is showing signs of decay after twenty-five to thirty years' growth. The chief ailments are dry rot at the butt and blister on the bark of the stem. The Douglas fir, *Abies Douglasii*, has been extensively planted for the last twenty years on the best ground, at about 25 feet apart.

Nursed with the usual forest trees, it is now well established, and remains healthy and vigorous, especially on virgin soil. Of these low ground plantations there is about 500 acres, which are carrying a healthy crop from ten to forty years of age. In more recent years extensive plantations have been formed, and within the last six years 300 acres have been planted with larch, Scots fir, and spruce. Douglas fir and hardwoods have been introduced where the soil was adapted for them. These young woods are in the most promising condition. They are well cared for, and protected with rabbit-proof fences. With the exception of a few small patches, none of the woodlands on the estate are vacant, and to these attention is now being directed, so that there will soon be nothing left for the planter's operations. The woods and plantations on the Falkland estate extend to about 1500 acres in all, and comprise some of the healthiest plantations in the county of Fife."

Leaving Falkland, the route was across the Howe of Fife, past Strathmiglo and the rural village of Gateside, and across the Ochils through the richly wooded and romantic Glenfarg into lower Strathearn. The well-known glowing description of the scenery of the district, as seen from the Wicks of Baiglie, an elevated spot on the north front of the Ochils, a little to the left of where Glenfarg debouches on the strath, in Sir Walter Scott's *Fair Maid of Perth*, does no more than justice to the splendid panorama seen from that coign of vantage, while he quotes with appreciation the lines of the poet :—

> " 'Behold the Tiber !' the vain Roman cried,
> Viewing the ample Tay from Baiglie's side ;
> But where's the Scot that would the vaunt repay,
> And hail the puny Tiber for the Tay ?"

A drive of a few miles through a well-cultivated and beautifully wooded country, past the Bridge of Earn, and over the shoulder of Moncreiffe Hill, brought the party in view of the lights of the "Fair City" of Perth, for darkness had fallen before the party, at about ten o'clock at night, drew up at the door of the Salutation Hotel—glad to attain its friendly shelter after the fatigues of a long day. Here, as on two former excursions, the headquarters of the Society were fixed.

SECOND DAY.

Thursday, 11th August.

SCONE PALACE, MEIKLEOUR, AND MURTHLY, PERTHSHIRE.

Those who were astir early in the morning spent an hour or two very pleasantly before breakfast in viewing the city of Perth and its surroundings, rich in stirring events of history and the romance of former days. Perth, anciently called St Johnstoun, was the capital of Scotland till the time of James III., who removed the seat of government to Edinburgh in 1482. The Fair City still takes precedence of all royal burghs, except the capital. Among the many objects which interested the arborists were the beautiful green expanses of the North and South Inches, the latter having a fine avenue of old trees running across it, along the sides of the road to Edinburgh; and the nurseries of Messrs Dickson & Turnbull, famed for the raising of coniferous trees and general forest plants, lying on the opposite side of the Tay, and stretching far up the steep slopes of the Hill of Kinnoull. Other objects worthy of a visit are too numerous to be detailed; but the ancient church of St John, said to be the oldest existing edifice in the city, and still a grand ecclesiastical pile, capacious enough to accommodate three congregations—of the East, West, and Middle parishes—with over 3300 seats; the City Hall, near the church, containing some interesting paintings; the High Street, South Street, Kirkgate, Skinnergate, Watergate, and Speygate, and particularly the fine esplanade stretching from the bridge downwards, called Tay Street, on which stand the modern Public Buildings for the city and county, presenting a handsome and picturesque frontage to the river, are all within a short distance, and should be seen by those who are making their first visit to the Fair City. Nor should the splendid view from the fine bridge spanning the Tay be omitted by those who admire scenery of the most varied and lovely description.

Breakfast was at 8 A.M. sharp, as the Excursion had to be on the way for Scone Palace, the seat of the Earl of Mansfield, at 8.30. There had been a shower of rain over night, but when the members turned out of the hotel the sun was shining brightly, and there was every promise of another fine day. This promise was more than realised. Driving off from the Salutation Hotel, around which a large crowd had assembled, we crossed the bridge and proceeded along the road to the left, on the north side of the Tay. About a couple of miles from

Perth, the policies of Scone, lying on the left, were entered by a plain wooden gate, and here the party were met and welcomed by Mr Lewis Bayne, forester on Scone estates; and Mr Alex. M'Kinnon, gardener, who accompanied them over the grounds. Pursuing our way along the drive through the richly wooded park, its fine arboreal features were greatly admired and specially noted by the large party, which now numbered over one hundred. Hard by the entrance was observed a remarkably handsome specimen of the weeping beech, which attracted general notice from its peculiarly graceful drooping branches and handsome proportions. Stretching away from the entrance is a fine irregular avenue of limes, elms, and oaks, and as we drive along we get beautiful peeps of the stately park studded with noble trees, and of a charming stretch of country beyond. It is still a demesne worthy of the ancient royal palace of Scotland, upon which we now gaze with patriotic pride—its softly toned red walls being in many places covered with ivy, which has crept up to the battlemented parapet. Over its towers floats the Mansfield flag. On nearing the palace, Lord Stormont did the Society the honour to come personally to receive them at the entrance to the private grounds, and to act as their guide in the inspection of the beautiful pleasure-grounds, gardens, and pinetum, rich in remarkable specimens of grand old trees, and luxuriant examples of the newer Coniferæ, which attracted the special attention of the Excursionists. Here it had been arranged that the company was to be met by a party of about sixty of the members of the British Association, who were to travel specially from Edinburgh to join the Excursion for the day, but as there were no signs of their arrival, the Society proceeded without them to view the policies. And first a visit was made to the splendidly kept pinetum. Many of the visitors would liked to have spent a little more time here than was permissible. Here all the hardy coniferous trees of the world find themselves assembled together. What a glorious congress they make; and what an educative value there is in such a pinetum as that at Scone. The lawn is like velvet; trees stately and rare rise in all directions, and to each appertains a neat label with its name, and in many instances the date of its planting. Not a few of the specimens are memorial trees, planted by royal and noble hands, and as such are proportionately valued above their neighbours. It would be out of place to merely catalogue the rare pines which grow in this well-tended spot. It may suffice to say that worthy of most special mention, perhaps, are examples of *Abies Albertiana*, *A. Douglasii*, *A. grandis*, *A. Menziesii*, *A. Nordmanniana*, *Wellingtonia gigantea*, *Araucaria imbricata*, and *Pinus monticola*.

We may here give the dimensions of the most notable among the numerous grand specimens of conifers in the pinetum and pleasure-grounds at Scone, as kindly supplied to us by the gardener, Mr M'Kinnon, who takes great care and pleasure in tending them.

CONIFERS AT SCONE PALACE.

Botanical Name.	Age.	Height.		Girth at 5 ft. up.	
	years.	feet.	inches.	feet.	inches.
Abies Albertiana,	30	52	6	5	4
,, *cephalonica*,	31	41	6	3	6
,, *concolor*,	31	41	4	4	0
,, *Douglasii*,	64	83	0	9	1
,, *grandis*,	31	48	6	4	10
,, *Hookeriana*,	20	19	0	...	
,, *Menziesii*,	39	72	8	8	6
,, *nobilis*,	39	73	3	7	0
,, *Nordmanniana*,	31	47	9	4	4
,, *Pinsapo*,	39	47	0	...	
Araucaria imbricata,	39	40	0	4	6
Cedrus atlantica,	39	53	0	4	6
,, *Deodara*,	37	45	6	4	6
Cupressus Lawsoniana,	31	30	0	3	10
Pinus austriaca,	31	43	9	4	1
,, *Cembra*,	39	46	0	4	6
,, *Jeffreyi*,	31	33	0	3	7
,, *monticola*,	39	73	0	6	0
,, *ponderosa*,	31	50	0	6	9
Taxodium sempervirens,	28	42	0	3	4
Thuja gigantea,	31	29	0	3	8
Thujopsis borealis,	31	31	0	...	
Wellingtonia gigantea,	31	62	0	7	6

Specimens of *Abies ajanensis*, *A. Alcoquiana*, *A. concolor violacea*, *A. pungens*, *A. p. glauca*, and others of later introduction, have been planted in recent years. They are fine thriving trees, varying in height from 10 to 15 feet.

A run through the garden was much enjoyed. One of the most beautiful things seen there was a border in front of one of the conservatories, which was a perfect triumph of horticultural art, being composed of Echiveras, Sedums, and Saxifrages in bloom, with lovely golden and silvery foliaged Cypresses, Junipers, and Retinosporas rising among them. In the grounds near the palace is a splendid specimen of the Douglas fir, which was planted in 1834. It is now over 80 feet in height. Let us pause for a moment in front of this stately tree to recite shortly the pathetic story of the gentleman whose name it bears. It is all the more appropriate, as he was born in the old village of Scone, which stood not far from the spot where the tree now grows. We take the narrative from Mr Hunter's book on *The Woods and Forests of Perthshire*, a work which should be in every forester's library :—

"David Douglas was born at Scone in 1798, and was the son of a working mason. He received his education at the parish school of Kinnoull, after which he served his apprenticeship in Scone Gardens. In 1818, when at Valleyfield, near Culross, on the Firth of Forth, in the gardens of Sir Robert Preston, he had excellent opportunities of studying the choice collection of exotic plants which it then contained ; and, through the kindness of the head gardener, he obtained access to Sir Robert's large botanical library. He was afterwards employed in the Glasgow Botanic Garden, where his botanical knowledge gained for him the favourable notice of Sir William Hooker, whom he accompanied in several of his excursions, including the one through the Western Highlands to collect materials for the *Flora Scotica*. He was subsequently recommended to the Horticultural Society of London by Sir William, and was sent several times to America to collect the indigenous plants for the Society. His first visit to America was in 1823, in which year he secured many valuable plants, and greatly increased the Society's collection of fruit trees. He returned home in the autumn of the same year, but was sent out again in July 1824, for the purpose of exploring the botanical riches of the country adjoining the Columbia river and southwards to California. When the vessel touched at Rio de Janeiro, he collected many rare orchideous plants, shot many curious birds in his voyage round Cape Horn, sowed a collection of garden seeds in the island of Juan Fernandez, Robinson Crusoe's island, and arrived at Fort Vancouver on the Columbia on the 7th April 1825. During this visit he sent home the first seeds of the Douglas fir to Britain, and on returning home in the spring of 1827, he crossed the Rocky Mountains to Hudson's Bay, and reached England in the autumn of that year. Through the influence of Mr Joseph Sabine, secretary of the Horticultural Society of London, he was introduced to the Literary and Scientific Society of London ; and he was elected, free of expense, a member of the Linnean, Geological, and Zoological Societies, to which he contributed some valuable papers. After remaining for a couple of years in London, he again sailed for North-West America to continue his favourite pursuit in the autumn of 1829. He afterwards visited the Sandwich Islands, where he met with his death under very shocking circumstances, having fallen into a pit made by the natives to ensnare wild animals. He was attacked by a bull already entrapped, was dreadfully mutilated, and eventually killed. The intelligence of his dreadful end, which took place on the 12th July 1834, in the thirty-sixth year of his age, created a profound sensation in the country. A very neat monument to his memory has been erected in his native village, where his talents and services endeared him to his fellow-townsmen."

All honour to Douglas, and other intrepid pioneers, to whose bravery, ability, and untiring research this country at the present moment owes many of its finest conifers.

Near Scone Palace, as is well known, still grow many ancient trees which link the present day with the centuries when the Stuarts reigned in Scotland. On a sloping bank at the south-west front of the palace is the famous sycamore, which was planted by Mary Stuart, Queen of Scots. A large limb is broken off, but it is still a handsome tree, with a dark umbrageous head. It is 13 feet 4 inches at 5 feet up, and is 63 feet high. It was noted, as a sign of decay, that several large fungi had made their appearance at a fork in the bole about 20 feet from the ground. Another sycamore, said to have been planted by James VI., girthed 12 feet 9 inches; and in the park below is an oak which was put in the earth by the same royal hands. It is 55 feet high, with a girth of 15 feet at the base, and 14 feet 1 inch at 3 feet from the ground, 13 feet 3 inches at 5 feet up, and has a spread of branches of 75 feet. A magnificent black Italian poplar, over 100 feet high, with cork-like bark, girthed 15 feet 6 inches; and there were many other notable trees in this locality worthy of measurement had time permitted. Skirting the Coronation Mound, we pass through the old entrance to the palace, and note on the right the ancient cross of the village of Scone. Beyond it is a lime avenue, which we traverse. The avenue is about ninety years of age. Forty years ago the trees, then well grown, were successfully shifted each 8 or 9 feet; and almost as remarkable was the feat achieved in 1881. A violent gale of that year blew down several of the limes, which were, however, hauled into the perpendicular position again, and the earth beaten well about their roots, while, to keep them up, strong ropes were attached to the neighbouring trees. This bold experiment succeeded, the limes took root again, and every year since they have been covered with abundance of fresh foliage.

Leaving the policies by the gate at the end of the avenue opening on the public road, a few neat, cosy-looking cottages, clustered with roses and other climbing plants, are all that now remain of the once populous village of Old Scone; the new village of Scone lying on the higher ground about two miles to the eastward. On the rising ground to the right, in front of us, was seen a fine thriving oak plantation, with a luxuriant undergrowth of rhododendrons, in which the late forester on the Scone estates, the well-known Mr William M'Corquodale, took great interest, and pointed to it with laudable pride on former visits of the Society, as a fine example of successful tree culture, combined with the ornamental and game-protecting character of the undergrowth.

Proceeding up the New Scone road, and turning in through a gate on the left, a long walk was taken through a fine oak wood of 300 acres, and about eighty years of age; and also through the extensive Muirward plantations, where thriving trees of many kinds were seen at various stages of growth. These fine woods afforded an opportunity to the practical foresters for comparing the growth and thriftiness of the various kinds of forest trees when grown under similar circumstances. A considerable area of Scots fir which was passed, was raised, we were informed, by Lord Stormont, from seed gathered in the "Black Wood" of Rannoch, and was planted here in 1849. It was thriving well, and exhibited all the characteristic features of the Rannoch "black fir" in its native habitat. In the Muirward plantations, Scots fir and larch were the predominant species, but many of the newer Coniferæ have been introduced, particularly in the young plantations, and they all seem to be thriving remarkably well, especially *Abies grandis, A. nobilis, A. Menziesii*, and the Douglas fir, the last being a favourite tree with the late Mr M'Corquodale, who planted it freely on the Scone estates wherever it was likely to thrive, and, so far as was seen, that was everywhere. A space of 13 acres in the plantations we were passing through was planted by him, in 1857, with a pure crop of Douglas fir, and the company examined it with great interest as they quickly walked through it, the trees being vigorous and well grown, and promising, when matured, to prove a remunerative crop. Six of them accurately measured in the autumn of 1891 by Mr Bayne, the forester, were respectively as follows :—

DOUGLAS FIRS IN MUIRWARD.

No.	Height.		Girth at 5 feet up.	
	ft.	ins.	ft.	ins.
1.	67	6	4	8¼
2.	58	2	4	7
3.	62	4	3	11
4.	70	6	4	3½
5.	58	10	5	1½
6.	62	5	2	11¼

In the Scone woods, and grown as ordinary plantation trees, are many fine samples of the Douglas and other firs introduced to Britain within the past sixty years; and in a mixed plantation, forty-one years of age, occupying a very exposed site in the district, the following trees occur. These measurements were also taken by Mr Bayne in the autumn of 1891, and it will be noticed how much the Menzies' fir has outstripped all the other trees. There is no Douglas fir in this plantation.

Conifers in Scone Woods.

Botanical Name.	Height.		Girth at 5 feet up.	
	ft.	ins.	ft.	ins.
Abies Menziesii (1), . .	60	5	6	1
,, ,, (2), . .	61	0	6	8½
,, *Nordmanniana*, . .	49	6	4	8
,, *Pinsapo*, . . .	37	0	3	2
Larix europœa, . . .	56	8	3	9
Pinus austriaca, . . .	36	10	4	0
,, *Cembra*, . . .	39	0	2	4½
,, *Laricio*, . . .	50	0	3	11
,, *sylvestris*, . . .	48	0	3	8

Two of the finest of the older trees in the Scone woods are a larch 97 feet 3 inches in height, with a girth of 8 feet 1 inch at 5 feet up, and a Scots fir, 74 feet 3 inches high, and 7 feet 10 inches in girth at the same distance from the ground.

With Lord Stormont and Mr Dunn making the pace, the walk through the woods, in the warmth of the day, was felt by many of the members to be rather fatiguing; and a quarter of an hour's rest, waiting until the last of the stragglers had appeared, was by no means unacceptable. Lord Stormont having been thanked for his great courtesy, the drive was resumed through a fine country rich in woodlands, attractive in its scenery, and waving with bounteous crops of wheat and corn. The company had a peep, in passing, at the fine new house of Newmiln, which is being built in this locality for Sir John Millais, R.A., to take the place of the one that was recently burned; and with Dunsinane Hill and Birnam Wood in sight, there was no lack of subjects of conversation to enliven the journey. At the village of Guildtown, a raid was made on the supplies of the small hostelry there by the tired and thirsty foresters, which will, no doubt, form a subject of conversation at many a cottage fireside in the long winter months, and pass into one of the wondrous legends of the place.

Continuing the charming drive, the Tay was first touched at Taymount, the scene of the marvellous fishing exploits of the immortal Mr Briggs, who here killed his first salmon, as duly narrated in the veracious pages of *Punch.* Stobhall, which we next pass *en route*, is an ancient stronghold, the seat of Lord Willoughby de Eresby—an edifice said to have been in existence seven hundred years ago, surrounded by beautifully wooded policies, in which grow many splendid old trees, among which are gigantic specimens of walnut, spruce, lime, larch, Scots fir, and others.

MEIKLEOUR.

Passing Cargill village and church, and crossing the Bridge of Isla, the policies of Meikleour commence on the left, and the Great Beech Hedge, for which Meikleour is famed far and wide, is immediately in front of us. This hedge is said to have been planted about 1746; it is about 86 feet in average height, and one-third of a mile in length, and being kept neatly and regularly trimmed, it has long been an object of great interest among arborists. Mr Matheson, the gardener and forester on the estate, who joined us here and acted as guide through the grounds and policies, mentioned that for the last fifty years the hedge has been regularly cut on the side next the road. On the other side the trees are left to grow very much at will. The hedge is pruned from a double ladder on wheels 30 feet high, which was modelled after the machines of the same kind used in connection with the cutting of the tall lime avenues at Versailles. The heavier branches are cut off with a single point saw, and the twigs, up to a length of 45 feet, with an averuncator. To prune higher than that is a work of some difficulty. One of the lithest of the foresters climbs as near to the top as possible, fastening himself to the strongest branch he can get by means of a belt round his waist, and holding on to another branch with his left hand. In his right hand he wields a light billhook, and by this method can prune to a height of 75 feet. Above that the necessity for pruning is not so great.

On the invitation of the Dowager Marchioness of Lansdowne, a flying visit was paid to the policies of Meikleour. The house occupies a charming situation on the north-east bank of the Tay, near to where the Isla mingles its waters with that noble river, and from it numerous delightful views can be obtained of the surrounding country. The mansion-house is a beautiful modern edifice designed by the late Mr Bryce, Edinburgh, in the French style—two chief features being a grand circular staircase and a tasteful balcony. The policies contain many rich sylvan features, and the avenue in front of the mansion is composed of lines of fine old trees, between which an arched vista is maintained towards Dunsinane Hill, standing conspicuously in the distance. This Gothic arch reaches a height of 70 to 80 feet, and is 80 yards in length. Several of the trees, particularly the beeches, which form the avenue are of great size, the largest of them girthing 13 feet 9 inches at 5 feet from the ground. The preservation of this unique arboreal feature is also maintained by means of regular pruning. In the immediate vicinity of this elegant mansion-house are many fine trees. Among these is a great silver fir fully 100 feet high, with a girth of 13 feet 11 inches, and with a diameter of branches of 60 feet, resting for the most part on the ground around the bole. Its *Abies Pinsapo* like habit puzzled some of the members. A Weymouth pine, *Pinus Strobus*, near it, with eleven main stems growing straight up from a bole about a foot from the ground, like so many Lombardy poplars, was a great curiosity. The bole girthed 14 feet 4 inches. There were also seen a grand scarlet oak, some fine Spanish chestnuts, and many tall and graceful limes.

Lady Lansdowne came upon the terrace of the mansion-house, and met several of the officials, who thanked her for her kindness. At Meikleour the British Association party, who were headed by Professor Bayley Balfour, the President of the Royal Scottish Arboricultural Society, caught up the arboriculturists. They only numbered some five-and-twenty—sixty being expected, but the rainy morning at Edinburgh had stopped a good many—and of that number about a third were ladies. They had been considerably delayed in the start for Scone, but they saw over the park and most of the other features around the palace. After a short walk to the top of the slope overlooking the river, where a lovely reach of it was seen and greatly admired, the party, thus reinforced, drove off for Murthly, passing through the pretty rural villages of Meikleour, Spittalfield, and Caputh. The Tay was again crossed by the handsome new bridge of Caputh, built a few years ago in place of an ancient ferry, which, when the river was in flood, was often perilous to use.

MURTHLY.

On the south bank of the Tay, from Caputh Bridge to Birnam, a distance of about four miles, lie the richly-wooded and extensive policies of Murthly Castle, the seat of Mr W. Steuart Fothringham, in which the rest of the day was to be spent.

It is classic ground to the arborist, "Great Birnam Wood" of Shakespeare's *Macbeth* forming a part of the policies. Several grand monarchs of the forest, which are supposed to have been vigorous trees about that era, are still seen in the district, although none of such a great age are now found within the precincts of the ancient Birnam Wood. At the present day Murthly is probably more famed for its exotic trees than for those of native origin. The whole extent of the beautiful pleasure-grounds is thickly studded with fine specimens of the coniferous order of trees. Every hardy species of exotic conifer that thrives in Britain has been more or less numerously planted within the past half century, and most of them are in a remarkably thriving state. The Araucaria from Chili, Deodar from Upper India, Douglas fir from British Columbia, and a host of other beautiful and interesting coniferous trees from all parts of the temperate regions of the earth, are growing here in the greatest luxuriance, and many of them in numbers not found upon any other estate in the country. Lovers of conifers, who were of the Excursion, had therefore a great treat at Murthly, where several days, instead of an afternoon, might be profitably spent in examining the beautiful habits and fine proportions of the thousands of conifers in the extensive grounds. Still, with the castles, both old and new, the chapel, avenues, gardens, terraces, and old trees, as well as the lovely and romantic landscape with the broad and clear waters of the Tay in the foreground, there is much beside the exotic conifers to attract the notice and satisfy the taste of all visitors to this estate.

Entering the policies at the East Lodge, the party reached Murthly at 2.15 P.M., and were most kindly welcomed by Mr W. Steuart Fothringham, with whom were his relatives Lord Carnegie and Mr Benson. Luncheon was served in a large marquee, and a company of 170 sat down to this repast.

Professor BAYLEY BALFOUR asked permission to make a few remarks. They were there that day on an unique occasion. The Royal Scottish Arboricultural Society had for years been in the habit of holding annual excursions to different parts of the country, but that day they had combined to form a joint excursion with members of the British Association, which had been holding its meetings last week in Edinburgh. He felt in speaking just now that he spoke in a dual capacity, in the first instance as President of the Royal Scottish Arboricultural Society, and in the second place as a member of the British Association. This was the first time that the Royal Scottish Arboricultural Society had visited Murthly. He need hardly say that they appreciated very much the honour which had been done them that day. He had only to ask them to look around the tables, and see the numbers who had taken advantage of the privilege which Mr Steuart Fothringham had given them, to see how much that privilege had been appreciated. In their drive through Perthshire that day they had passed through a lovely country, and at last had reached Murthly, which some of them had seen before. Others were visiting it for the first time. He was quite sure that those who had not seen it before would acknowledge, before the day was over, that it surpassed anything that they had seen of the kind elsewhere. This part of Scotland appeared to be really the home of the conifer. The situation, shelter, the moisture of the atmosphere, as well as the soil, seemed to be particularly favourable to the growth of conifers. He did not mean to say that deciduous trees did not also grow well here; but he thought he was right in dwelling upon the point that coniferous trees were the special feature of this locality. They would not only find admirable individual trees, but specimen conifers growing in picturesque groups in a most luxuriant way. He believed that many of their friends from the south of England and other places would be surprised to find the wealth of vegetation that was exhibited upon this estate. In proposing a vote of thanks to Mr Steuart Fothringham for his hearty reception, he thought he might say that this was a very important occasion, on which they could show to their English friends what the Scottish people were doing for forestry. The Royal Scottish Arboricultural Society had for years laboured in the cause of forestry. The annual excursion was a very important educative influence, and the meeting they were having that day would not, he was sure, be the least important of any of those which the Society had held. This educative influence of the Society would, he hoped, go on increasing; and in a few years he trusted that they would perfect their educative system to such an extent that foresters from Scotland would be recognised even more than they were at present all the world over. He asked them to accord their heartiest vote of thanks to Mr Steuart Fothringham for the very great privilege he had given them that day of coming to view his grounds, and in the second place for the very cordial and hearty manner in which he had entertained them.

Mr Steven Bourne, on behalf of the members of the British Association, spoke of the great pleasure it had given him, in driving through the country that day, to see the land everywhere so well utilised. Coming from the south as he did, he was quite surprised to see the luxuriance of the crops. It spoke volumes for the excellent agriculture of the country. He could not help drawing a contrast between it and Ireland, with which also he was well acquainted, though Ireland in many respects was exceptionally favoured. What a pleasure it had been, for example, to see as they drove along the road the humblest cottage covered with flowers, whereas in Ireland it was the rarest thing to see a flower in connection with the houses of the peasantry. In Ireland, too, they might pass through large tracts of country and rarely see a tree. Here the land was clothed with woodlands, which added not only to its value but to its picturesque aspect. It was with great pleasure that they had come north that day to see something of the woodlands of Perthshire, and he joined with Professor Bayley Balfour in thanking Mr Steuart Fothringham for his reception of them that day.

Mr Steuart Fothringham, who was received with much applause, said he thanked the ladies and gentlemen assembled round the table for the manner in which they had received the speeches of the two gentlemen who had been good enough to propose a vote of thanks to him. The only thing he had to say was, that he was very glad to see them there. It was little use having fine trees on an estate if they were not to be used for purposes of education, and of allowing those interested in the growing of them to see what had been done here with them during the last half century. Many of them had been planted there for a very long time. The days of the planting of some of them were known and remembered. Of others they had not the record. It would help them in their studies to see how the trees would grow in this country. At the Conifer Conference many people seemed quite surprised that they were able to grow the newer conifers so well in what he believed they called "barren and destitute" Scotland. But after they had seen specimens of wood from Murthly and other parts of the country, they were forced to come to the conclusion that they could grow conifers in Scotland just as well as they could do in England. "And now, ladies and gentlemen," said the young laird of Murthly in conclusion, "I invite you to come with me through the grounds and see for yourselves."

Under the genial leadership of Mr Steuart Fothringham, the rest of the afternoon was most agreeably spent in visiting this enchanting arboreal paradise, where something of interest met the eye at almost every step, and the eager looks and inquiring remarks of the numerous company, plainly told how deeply they were interested in all they saw, and how much they admired the sylvan riches of Murthly. The gardens, lawns, terraces, drives, avenues, and approaches to the castle at Murthly cover an area of over 100 acres. The woods and policies on the estate around are about 2757 acres in extent. The walk which the members of the Society had through this beautiful demesne could not fail to recall the days when the newer Conifers, with which the policies and woodlands are so profusely adorned, were first introduced into this country. The romance of these days, including as it does stories of adventure in almost unknown lands, and a spirit of commercial and scientific enterprise which was creditable to all concerned, has still to be written. It exists in fragmentary shape in many volumes, but a work which gave a connected narrative of the wanderings in search of trees by Douglas and Jeffrey and other mighty travellers in the wilds of America and elsewhere, would be greatly appreciated by arboriculturists. The laird of Murthly of that day was Sir William Steuart, Bart., who in earlier life was an enthusiastic traveller and naturalist. When travelling in the backwoods of America, he made it his duty and pleasure to collect the seeds of many coniferous trees which were scarcely known in this country. In particular, on the Rocky Mountains and in the North-West Provinces of America, he secured the seeds of many rare conifers and brought them home to Murthly, where, with other choice pines from other countries of the world, they are now growing with a grace and luxuriance not to be surpassed in any other part of the country. These beautiful trees have been planted out with a skilful hand. They form avenues and groves and tree-clad terraces, all designed to produce the most pleasing effects ; and the company wandering in this huge pinetum, as the policies and woodlands may justly be called, found at every step some fresh object of admiration and pleasure.

Let us recount a few of the wonders. Leading from the castle to the private chapel is an Araucaria avenue about 170 yards in length. The trees in it are over 30 feet in height, and in the healthiest condition. To the south-east of the new castle there is a grove of about twenty Araucarias, even grander than those in the avenue. Parallel with this avenue is the Yew Walk, composed entirely of yew trees. Some of them are of great age. The branches meeting overhead are so trimmed that the avenue resembles one long Gothic archway, dimly lighted and impressive, and with a brown carpet formed by the fallen leaves of the yew. Adown this solemn walk the dead bodies of the lairds of Murthly are borne when being removed from the castle to the chapel on their way to their last resting-place.

Near the principal entrance to the castle is the Deodar

Avenue, about 150 yards in length, formed of trees notable for their beauty and uniformity. The Deodar or Sunk Terrace, a short distance from the castle, is one of the sights of the place. It is reached by a broad flight of steps. The terrace is about 170 yards in length, and the trees, about 35 feet high, are thriving splendidly. Along the slopes of the terrace are a fine collection of hybrid rhododendrons, and when they are in bloom, their varied colours against their own dark foliage and the lighter green of the Deodars have a most charming appearance. There are also two grand avenues composed entirely of Douglas firs. One is known as the Douglas Straight Avenue, consisting entirely of examples of this tree, averaging 80 feet in height; and the other, by the river, known as the Douglas Winding Terrace Avenue, about a quarter of a mile in length, and consisting of fine well-grown trees about forty years of age. This terrace is a most interesting sight. The trees run from 60 to 85 feet in height, girth well, and their graceful fan-shaped branches spread out nobly around them. The soil on which they grow is a light sandy loam of average quality resting on deep gravel, while in other places the situation is rather marshy. Behind the Douglas pines one meets at various points in these avenues groups and specimens of other handsome trees, such as *Abies Hookeriana*, *A. Veitchii*, *A. brachyphylla*, *A. concolor*, *A. polita*, and *Pinus monticola*. At the north end of the Deodar Terrace is a line of most handsome specimens of *Cupressus Lawsoniana*—as fine as can be seen anywhere in the country. Then there is what is called the "Low Terrace," about a quarter of a mile in length, planted with Douglas firs, araucarias, cypresses, cedars of Lebanon, and Prince Albert's fir; and in this neighbourhood is "The Rosary," surrounded by a raised bank with Lawson's cypresses, *Cryptomeria elegans*, araucarias, and hemlock spruce.

This does not by any means exhaust the arboreal treasures of these lovely policies. A fine sight is the Dolphin Terrace, about half a mile in length, containing magnificent specimens of *Abies Menziesii*, averaging 70 feet in height, *Abies nobilis*—lovely trees they are, and other stately conifers. Adjoining it is a short avenue of purple beeches, contrasting well with the conifers; and the rivulets, waterfalls, and ornamental pools in this part of the grounds greatly enhance its appearance. There is likewise the American Garden Terrace, above half a mile in length, consisting of Douglas firs, Wellingtonias, *Abies Nordmanniana*, *A. lasiocarpa*, *A. nobilis*, *Cryptomeria japonica*, and other trees. Murthly estate can boast of possessing three of the first Wellingtonias sent out by Veitch about 1856; and in the neighbourhood of the American Terrace is one of these interesting trees, which is now about 70 feet in height. The Grand Avenue, broad and stately, is a quarter of a mile in length. Leading direct to the castle, it consists of four rows of lime trees of rare beauty and uniformity, with yews between; and between the central road and the trees are broad grassy lawns. At one end is a triumphal arch, and joining it from the east is a long avenue of *Pinus Cembra* and Wellingtonias, with oaks in the background.

In the Lime Avenue, which was planted in 1711, there are many handsome trees. The best dozen of these run from 10 feet to 8 feet in girth, and their height is from 100 to 120 feet. On the day that we saw them the limes were in flower, scenting the air with their delightful fragrance.

All these grand arboreal features, and many more of which time and space would fail to tell, were formed under the direct supervision of the late Sir William Steuart, who also added greatly to the grass drives which intersect every portion of this charming property. One of these followed by the party for some time brought Birnam Hill prominently into view; and in the course of the walk several trees were taped or their height specially noted. As we give a table of the large coniferous trees, these need not be individually referred to here. Mention, however, may be made of two Spanish chestnuts in one field, one 70 feet high, 18 feet 7½ inches in girth at 5 feet up, and 26 feet 5 inches at a foot from the ground, and the other 80 feet high, 17 feet 1½ inch in girth, and with a spread of branches of 38 feet. A bird cherry had a girth of 11 feet 9½ inches, and a beech was 14 feet 6 inches at 5 feet up, with a spread of branches of 65 feet. These trees were in the park, which the party entered by a strong and serviceable flight of steps made of Douglas fir. A cedar of Lebanon was 11 feet 8 inches in girth and 65 feet 10 inches in height.

The present laird of Murthly is a gentleman who takes the keenest interest in arboriculture, and the greatest of pleasure and pride in the arboreal treasures which have fallen to his lot to possess. At the recent Conifer Conference at Chiswick, London, he was one of the largest exhibitors, and was awarded a Silver Medal for the number and excellence of the specimens of Conifers which he contributed. Although the policies do not now present any great scope for additional planting, it is certain that they will be maintained in their present high state of perfection, and their beauties added to, wherever that is possible.

The following is a list of some of the finest specimens of Conifers at Murthly, as supplied by Mr Laurie, the gardener on the estate :—

Conifers at Murthly.

Botanical Name.	Situation.	Height.		Girth at 5 feet up.		Diameter of Branches.	
		ft.	ins.	ft.	ins.	ft.	ins.
Abies Albertiana, .	Low Terrace, . . .	70	2	5	5	32	0
,, *Douglasii*, . .	Short Deodar Avenue, .	86	6	8	10	24	0
,, ,, *Standishii*,	Near "Horse-Shoe," .	63	1	6	8½	23	6
,, *grandis*, . .	Low Terrace, . . .	64	2	4	8	22	6
,, *magnifica*, . .	Near Old Castle, . .	31	9	2	7	9	0
,, *Menziesii*, . .	By Carriage Drive, . .	91	9	9	7	45	0
,, *nobilis*, . .	Dolphin Terrace, . .	75	4	6	4	24	0
,, *Nordmanniana*,	,, ,, . .	58	6	4	0	12	0
,, *orientalis*, . .	,, ,, . .	38	0	2	8	9	0
,, *Pinsapo*, . .	Near Rose Cottage, . .	35	8	......		......	
,, ,, . .	,, Old Castle, . .	34	8	......		......	
Araucaria imbricata, .	,, New Castle, . .	42	0	4	0	10	10
,, ,, .	,, Chapel Walk, . .	42	6	4	0	9	0
Cedrus Deodara, . .	,, Old Castle, . .	51	3	6	8	26	0
,, *Libani*, . .	Low Terrace, . . .	65	10	11	8	......	
,, ,, . .	Flower Garden, . .	......		9	4	......	
Cryptomeria japonica,	Winding Terrace, . .	36	3	4	2	26	0
Cupressus Lawsoniana,	Near Sunk Terrace, . .	51	0	3	9	11	6
,, *thyoides*, .	,, Deodar Avenue, .	33	6	2	6	5	4
Libocedrus decurrens, .	Foot of Sunk Terrace, .	34	8	3	6	5	0
Pinus monticola, .	Near Rose Cottage, . .	66	0	4	0	10	8
,, ,, .	,, "Horse-Shoe," .	67	0	5	6	18	0
Taxus baccata, . .	Flower Garden, . .	......		10	3	......	
Thuja gigantea, . .	Sunk Terrace, . . .	58	0	3	9	15	0
Thujopsis borealis, .	,, ,, . . .	50	6	1	10	10	0
Wellingtonia gigantea,	American Ter.; pltd. 1857,	66	9	9	3	26	0
,, ,,	,, ,, ,, 1861,	61	0	6	6	......	
,, ,,	Winding Terrace, . .	56	6	8	1	11	0

There are numerous other specimens of most of these about as fine as the above, growing in various parts of the grounds; and the collection of Conifers grown at Murthly numbers in all over seventy species, besides many varieties. The heights were taken by a man going up the tree with a long rod, and the measurements are all as accurate as it is possible to take them. They constitute a useful record.

TAYMOUNT.

The return journey to Perth was made by the direct road along the south side of the Tay; passing at about three miles from Murthly the famed Douglas Fir plantation at Taymount, which the party halted to inspect, through the kind permission of the Earl of Mansfield, the proprietor of the estate. Situated a short distance off the road, it was soon reached by a few of the most active of the party, the practical members of which expressed their high satisfaction with what they observed of the Douglas fir, here growing as an ordinary plantation tree without any mixture of other kinds. The trees were a full crop of straight clean boles, as shapely and symmetrical as gun barrels, without a branch to the height of 25 to 30 feet, and with a dark green close canopy overhead, a perfect beau-ideal of good forestry. The plantation covers about 14 acres, and was planted in 1860. The soil appeared to be of a moorish texture, and by no means of an inviting nature; still the Douglas firs were thriving admirably in it, and the remark was freely expressed that it was among the best illustrations of skilled practical forestry seen on any of the excursions. A few specimens of the trees were measured by the forester, Mr Bayne, in the autumn of 1891, the dimensions of which were as follows:—

Douglas Firs at Taymount.

No.	Height.		Girth at 5 feet up.		Stem to First Branch.
	ft.	ins.	ft.	ins.	ft.
1.	68	0	5	4	27
2.	69	0	5	1	28
3.	63	6	4	9	23
4.	67	6	4	10	23
5.	77	0	4	4	35

About three miles nearer Perth, on the left of the road, there was pointed out as we passed the site of the battle of Luncarty, where the Scots, under Kenneth III., in 990 finally overthrew the Danes, and where, for their timeous succour at the crisis of the fight, the noble family of Hay acquired both fame and lands. The most notable feature of Luncarty at the present day is the extensive bleachfield, said to cover about one hundred and fifty acres, and to be one of the largest of its kind in the country. Perth was reached about half-past eight o'clock—the members more than pleased with the grand day they had enjoyed.

Annual Dinner.

The annual dinner of the Society was held at nine o'clock, in the Salutation Hotel, under the presidency of Professor Bayley Balfour, who was supported by Alderman James Rutherford, J.P., Redcar, Yorkshire; Mr John Alexander, Ceylon Forest Department; Mr David P. Laird; and Mr W. J. Moffat, secretary. Mr M. Dunn, Dalkeith, and Mr James Watt, J.P., Carlisle, were the croupiers.

The loyal toasts having been honoured,

Mr James Watt, Carlisle, proposed the toast of the British Association, and expressed the pleasure it had given the Royal Scottish Arboricultural Society to have been joined that day by a section of its members.

Professor Bayley Balfour, in reply, said it was very good of the Royal Scottish Arboricultural Society to make arrangements for the members of the British Association joining their excursion that day. He only regretted that a larger number of the British Association did not take advantage of it. Those who had attended, however, had enjoyed themselves very much.

Mr Dunn gave as a toast, which was cordially received, the health of the senior members of the Royal Scottish Arboricultural Society, which was replied to by Mr Boa.

Mr Michie, Her Majesty's forester, Balmoral, proposed the nursery trade, which was responded to by Mr Gossip of Inverness.

The visitors were proposed by Mr Laird, and replied to by Mr Goodchild, Suffolk.

THIRD DAY.

Friday, 12th August.

METHVEN, LYNEDOCH, GLENALMOND, THE CAIRNIES, KEILLOUR, AND BALGOWAN.

Owing to the number of places to be visited and the consequent frequent stoppages, an early start had to be made to-day so as to accomplish the journey in time to catch the evening trains for the north and south at the close of the Excursion. Throughout this day excellent weather was also enjoyed. The sky was overcast in the morning, and, more than once in the course of the day, it looked as if a rain-storm were brewing; but at times the clouds cleared away, and blinks of sunshine were not unfrequent.

Perth was left at 9 A.M., and the drive, through a prettily-wooded country, passes Huntingtower Castle, an ancient seat of the Gowrie family, and the scene of the "Raid of Ruthven." Five miles out is Methven Castle, the seat of William Smythe, Esq., where the first visit of the day was to be made. The estate has been owned by the Smythe family since 1664. The fine baronial castle dates from 1680, with many modern additions and conveniences. The castle stands on a site overlooking the beautiful and well-kept grounds, as well as a wide stretch of the open country. A large number of trees of great size stud the grounds and policies, and many fine specimens of the newer Coniferæ are interspersed among them. The famed "Pepperwell Oak" stands in the park in front of the castle, and is probably the most notable tree of great age in the parish. Many historical events took place in the troublous times of the Middle Ages in the ancient Wood of Methven, which was then of much greater extent than what at present exists on the Methven estate. It is now comprised in about two hundred acres of ancient woodlands lying along the banks of the river Almond, and containing many fine old trees and picturesque scenes. The party had the privilege of walking through it on the way from Methven Castle to Lynedoch, as will be duly narrated, and the members viewed with much interest the ancient remains of this celebrated wood.

We entered the Methven Castle policies at the East Lodge, near to the village of Almondbank. The drive of about a mile and a half from the lodge to the castle, passes first through a fine stretch of woodland in which oak predominates, skirts the north side of the Loch of Methven, with its rustic boat-house and numerous waterfowl, and pursues its way along high ground, from which splendid views are obtained, through part of the old forest of Methven, with oak and birch and hazel growing in a state of nature. Alongside of the drive a number of the newer conifers have been planted among the hardwoods, and are thriving admirably; as also some fine tall larches, which were in vigorous health and perfect foliage. About half a mile from the castle the party were met and cordially welcomed by Colonel Smythe,[1] the eldest son of the proprietor of the estate, who was accompanied by his brother, Mr F. H. Smythe, and Mr Whitton, the gardener, who acted as leaders over the estate. A commencement was at once made with an inspection of the arboreal treasures of this interesting demesne. Colonel Smythe had brought with him a book containing most interesting details concerning a number of the notable trees of the place, which had been carefully kept for many years by Mr Bishop, who occupied the position of landsteward on the property from 1794 to 1850, when he died. After that time the record, unfortunately, was not kept up so continuously; but Colonel Smythe, who is a member of the Royal Scottish Arboricultural Society, has taken the matter in hand again, and has arranged for the

[1] Now the Laird of Methven.

continuance of these "Chronicles" of Methven. A small clump of Spanish chestnuts was pointed out, which, it was set forth in the chronicles by Mr Bishop, had been planted in 1832 from seed which ripened on other trees upon the estate in 1826. This was a rare occurrence at Methven, and, so far as is known, has not happened again, though the same trees are yet in perfect health, and bear nuts annually. One of the 1832 chestnuts was measured in 1880, and was 6 feet 2 inches in girth. Now it girths 6 feet 10 inches, so that in twelve years it has added 8 inches to its circumference. Passing the north front of the castle, a number of tall and very large trees were seen in the grounds to the westward behind the gardens. One of a line of stately beeches girthed 12 feet 7 inches. It had a fine clean bole, and was in a very healthy state. We next had a glance through the nicely kept gardens and hothouses, which are in perfect harmony with the fine old baronial castle. Beautiful shrubs, roses, and choice herbaceous plants occupy the borders in the charming old-fashioned way, and give them a quaint interest which prim-kept modern borders are generally without.

In the dell below the castle an ash tree growing by the side of the burn was pointed out, concerning which several very interesting particulars were recorded. When a sapling 3 feet 9 inches high, it had been picked up on the roadside by the late Colonel Smythe, the present proprietor's brother, and planted in 1799. It became a great favourite, and its girth was diligently recorded, sometimes every year, sometimes at longer intervals, between 1811 and 1850. In 1811 we learn that at 3 feet from the ground it was 1 foot 6½ inches; and the subsequent measurements were recorded as follows:—

Date.	Girth. ft.	ins.	Date.	Girth. ft.	ins.
1812,	1	8	1845,	4	5½
1818,	2	3	1847,	4	6
1819,	2	4¾	1849,	4	8½
1820,	2	6	1850,	4	9½
1821,	2	8	[1] 1863,	5	6
1827,	3	2	1880,	6	6
1829,	3	4½	1883,	7	0
1832,	3	5½	[1] 1891,	7	1
1834,	3	10	1892,	7	2
1841,	4	2			

Colonel Smythe, before his death in 1847, gave orders that his horse should be shot and buried underneath the shade of

[1] At 4 feet up. The other measurements presumably are at 3 feet, following the course of the first measurement.

the ash tree. This was actually carried out, as was poetically set forth on a card which until recently hung around the tree, but has now disappeared—

> "Donald's dead, his troubles ended,
> From future drudgery set free,
> And now his body lies extended,
> To nurse his master's foundling tree."

Of a second ash planted alongside of it in 1805, there is also a continuous record of its growth since 1811, when it was $3\frac{3}{8}$ inches in girth at 3 feet up. The measurements since, as recorded in Mr Bishop's book, are—

Date.	Girth.		Date.	Girth.	
	ft.	ins.		ft.	ins.
1821, . . .	1	$0\frac{3}{4}$	1845, . . .	2	9
1827, . . .	1	$5\frac{1}{2}$	1863, . . .	3	7
1829, . . .	1	7	1880, . . .	4	8
1834, . . .	1	$11\frac{1}{2}$	1891, . . .	5	1
1842, . . .	2	4	1892, . . .	5	3

Crossing the burn by a rustic bridge, we are close to the largest, and possibly the oldest, tree in the place, the Pepperwell Oak, as already stated, which stands near the bottom of the slope below the mansion-house. The earliest authentic account of it which Bishop says he could get was in 1722, when David Smythe, then the laird of Methven, was confined in the Tower of London for his political opinions. Under these circumstances there came a man to Methven Castle, who, thinking that the wife of the imprisoned laird might want money, offered her for the tree 100 merks Scots, which was equal to £5, 12s. 6d. of our present currency. This, of course, was refused. In reference to its age, Bishop says that he attended an old man's funeral in 1795, who had been heard to say that he knew a man who had repeatedly thought of cutting the tree down while young, as a supple for his flail, so that, Bishop remarks, "it may not perhaps be so old as it looks." These old men's stories regarding trees have always had to be received *cum grano salis*. Recalling the aspect of some of the Sherwood Forest oaks, one would say that the Pepperwell Oak was of considerable antiquity. The measurements of the tree from 1795, at 4 feet up, are exceeding instructive. Here they are,—

Date.	Girth.		Date.	Girth.	
	ft.	ins.		ft.	ins.
1795, . . .	14	6	1847, . . .	18	1
1811, . . .	16	0	1850, . . .	19	1
1830, . . .	17	0	1880, . . .	19	7
1842, . . .	17	7	1892, . . .	19	11

In 1891 Colonel Smythe measured it, and got 19 feet 10 inches, and on our visit, when the tape was passed round it, the bole measured 19 feet 11 inches; but this apparently large increase in a season may be easily accounted for otherwise than by supposing that the tree is still adding rapidly to its girth.

Bishop writes further regarding it that, although the tree evidently belongs to the species of British oak known to botanists as *Quercus robur pedunculata*, it had in its flowers certain characteristics of *Q. r. sessiliflora*, a remark which showed that Bishop had a very observant eye. The *sessiliflora* characteristics were found by the members of the Arboricultural Society, just as they were by Bishop, though no doubt existed that the Pepperwell Oak was of the *pedunculata* variety. In 1836 the tree seems to have been surveyed, and it was estimated to contain about 700 feet of timber, which, at 3s. a foot—the price current then—was worth £105. The Pepperwell Oak has, however, been battered by storms since that time, and has lost three very large limbs, which has destroyed its symmetrical appearance, though so far it has not shown any signs of decay. Underneath it is a seat made from a slab of beech cut from a tree which grew farther up the slope, and which measured 4 feet 8 inches in diameter.

Among other large trees which were measured on this sunny southern slope was a larch, which in 1882 was 12 feet 4 inches in girth, and was now found to be 12 feet 6½ inches; and a clump of Spanish chestnuts—those from which the seed already referred to was procured. The largest of the group was 11 feet 5 inches in circumference in 1880, 12 feet 5 inches in 1891, and 12 feet 7 inches in August 1892. A grand oak with a fine straight bole, which was 13 feet 1 inch in 1880, gave now a measurement of 14 feet; and an ash, which was 13 feet 6 inches in 1880, was now 14 feet in girth. Running aslant of the slope, a nice avenue of Deodars was seen which had been grown from seed sent home by Lord Elgin in 1863 or 1864, when he was Governor-General of India. Between the castle and the gardens are a large number of fine specimens of the newer Coniferæ, among which is a fine example of *Cryptomeria japonica*, 5 feet 9 inches in girth at 4 feet up, and about 40 feet in height; an *Abies Hookeriana* (in cone), 30 feet high; a *Wellingtonia gigantea*, 61 feet in height, 8 feet 2½ inches in girth at 4 feet up, 12 feet 3 inches at the base, and covered with cones; and an *Abies Albertiana*, 70 feet in height, were also inspected.

The following list of the finest specimens of conifers at Methven Castle, and their dimensions, has been kindly furnished by Mr Whitton, who has raised many of them from seed or cuttings, and they bear good evidence of the skill and care he has bestowed upon them :—

Conifers at Methven Castle.

Botanical Name.	Age.	Height.	Girth at 5 feet up.	
		feet.	ft.	ins.
Abies Albertiana, . .	23	68	4	7
,, *Douglasii*, . . .	33	65	6	10
,, *grandis*, . . .	21	35	4	0
,, *Hookeriana*, . .	34	15	1	1
,, *magnifica*, . . .	13	25	2	2
,, *Morinda*, . . .	50	50	6	11
,, *nobilis*, . . .	21	35	2	7
,, *Nordmanniana*, .	22	35	2	5
,, *Pattoniana*, . .	34	25	2	2
Araucaria imbricata, . .	35	35	4	3
Cedrus atlantica, . .	35	20	3	0
,, *Deodara*, . . .	25	30	2	8
,, *Libani*, . . .	150 (?)	90	9	10
Cryptomeria japonica, . .	35	30	5	5
Cupressus Lawsoniana, .	33	45	5	4
Libocedrus decurrens, . .	30	25	3	5
Pinus Cembra, . . .	50	35	3	9
,, *Lambertiana*, . .	50	30	2	7
Thujopsis borealis, . .	33	37	3	4
Wellingtonia gigantea, .	25	61	7	5

Mr and Mrs and Miss Smythe received the visitors on the castle terrace, and Mr Smythe (who is over ninety years of age) addressed a few cordial words of welcome to them. The place, he said, had many historical associations connected with it. At one time it belonged to the Royal House of Stuart. It was there that Margaret, Queen Dowager of James IV., and daughter of Henry VII. of England, died in 1540, and other royal associations lingered round the castle. The estate passed to the Lennox family, and was by them sold in the end of the seventeenth century to one of his ancestors, and it had remained with them ever since. He was glad to see them there, and he trusted they had enjoyed their walk through the grounds.

Before the party passed on, cheers were given in honour of Mr and Mrs Smythe and family.

[It may be noted here that this was the last public appearance of Mr Smythe. He died full of age and honour just one month after the Society had visited his beautiful demesne, and the tributes of respect which were paid to him by the public press of the country showed how his long and useful public life had been appreciated by his fellow-countrymen.]

Before the party left Methven they were entertained to refreshments on the lawn in front of the castle.

Professor BAYLEY BALFOUR tendered the cordial thanks of the company to Mr and Mrs Smythe and family for their kindness, and expressed a hope that Colonel Smythe might see his way to allow some of the interesting records, of which mention has already been made, to be published.

Colonel SMYTHE, in reply, expressed the pleasure it had been to them all to see the Arboricultural Society there that day. He had been a member of the Society for the past ten years, but he had never been able to attend any of the meetings. Professor Bayley Balfour had referred to Mr Bishop's book. If it would be of any use to the Society, he should be glad to put it at their service. The record had been extremely well kept up to forty years ago, but since then there had not been so much put in. A beginning, however, had again been made, which he hoped would be continued.

Leaving the castle, the party walked or drove through a bit of Methven Wood, heavily timbered with oak, larch, and beech, to the deep and romantic valley of the Almond, to see one of the largest beeches on the estate. The ground around it has been cleared to give this handsome tree light and air; and a more beautiful example of *Fagus sylvatica* could not be desired. It ranks among the largest beeches in the country. It is over 100 feet in height, with a magnificent head adorned with the richest foliage. In the *Woods and Forests of Perthshire*, 1883, the girth of this grand tree is given at 14 feet 9 inches at 5 feet up. On measuring it the arborists got a girth of 16 feet 8 inches. It has a splendid bole of 20 feet, and divides there into five main limbs, each of which is in itself a respectable tree. In the immediate vicinity of the beech is a fine oak, which, however, from want of time, was not measured. In 1883 it was 8 feet 9 inches in girth at 5 feet from the ground; and, throwing its arms over the Almond, is a handsome sycamore, also of large girth. The beech, it should be said, was grandly anchored in the ground by roots which gave at the base of the tree a measurement of nearly 24 feet; but it was observed with regret that rabbits had eaten away a good deal of the bark from the base. Colonel Smythe mentioned that he meant to surround the tree immediately with a rabbit-proof net.

Methven Wood, through which we have been passing, is redolent of traditions of both the great Scottish liberators, Wallace and Bruce. There was a battle fought here between Bruce and the Earl of Pembroke in 1306, which ended disastrously to the Scots, who, tradition says, were encamped on this very spot where the beech tree now stands, cooking their supper, when Pembroke's forces burst in upon them.

On the way up from the dell attention was called to a fine oak which had been struck by lightning in a recent storm. The lightning had loosened the bark on one side, and had left a spiral-like gap about 2 inches in width down the injured side of the bole.

LYNEDOCH.

Lynedoch, belonging to the Earl of Mansfield, was the next stoppage. The drive from Methven Wood to it was through some fine woodland scenery, on the north side of the river Almond, which was crossed at the bridge of Dalcrue. The chief objects of attraction at Lynedoch—which formerly belonged to General Sir Thomas Graham, of Peninsular War fame, afterwards Lord Lynedoch—are the two famous Douglas fir trees, of which all arborists have heard, the smaller of the two having produced the seed from which has been raised the many thousands of Douglas firs now growing on the Scone estates. In the sheltered valley where the Douglas firs stand there are many other fine specimens of forest trees, both spruces and firs, ranging from about 10 to 14 feet in girth, and towering to a height of over 100 feet, with long, straight, clean boles of excellent timber. A short distance farther up the valley, on Dronach Haugh, is the widely heard of grave of "Bessie Bell and Mary Gray," who having fled from Perth in 1666, to escape the plague, were in this secluded spot attacked and carried off by the fatal disease, and lie buried where they died, in their sylvan retreat. Their romantic story and sad fate attracts many visitors from distant parts to this sequestered nook in the valley, to read on their tombstone the simple epitaph, "They lived—they loved—they died."

To Lynedoch, and afterwards to The Cairnies, the party were accompanied by Colonel Smythe and Mr F. H. Smythe. On arriving at Lynedoch the party left the carriages and proceeded a short distance on foot to view the famed Douglas firs growing in a small haugh on the banks of the river Almond. The larger of the Douglas firs, planted in 1834, was 93 feet in height and girthed 12 feet 1 inch at 5 feet up. When the Society last visited Lynedoch, in 1884, the measurements were—height, 92 feet, and girth, 10 feet 10 inches; giving about 180 cubic feet of timber. It is a magnificent tree, and is in the most perfect health. The other is 72 feet 2 inches in height—its leader having been broken several times—and it girths 11 feet 2 inches. In 1884 it girthed 9 feet 10 inches at 4 feet up, and 6 feet 10 inches at 27 feet up. It is this tree ("Eve" it is named) which is the parent of all the younger Douglas firs, which are so plentifully disposed on the Earl of Mansfield's estates, and for the sake of its cones, it is enclosed within a squirrel-proof fence, while all the trees within jumping distance around it have been cleared away. Last year something like 12,000 cones were gathered, and as many as 30,000 cones are said to have been gathered off it in a single season. Among other big trees in this sheltered spot were two silver firs over 100 feet in height, and girthing respectively 11 feet 11 inches, and 13 feet 8 inches. There was also a grand spruce, *Abies excelsa*, towering to over 106 feet in height, with a girth of 10 feet at 5 feet up,—the finest spruce on the estates.

These trees were surveyed with the greatest admiration. At Lynedoch the woods have been very greatly improved since they were purchased by the Earl of Mansfield about forty years ago; and the members rambled through them for the best part of an hour—the timber being everywhere of great value.

GLENALMOND AND THE CAIRNIES.

The carriages were again mounted, and what proved to be a long drive was undertaken to the Logiealmond district, where several estates were down on the programme to be visited.

Pursuing an oak-shaded road for several miles up the valley, we passed Logie House and policies, a beautiful seat of the Earl of Mansfield, with some splendid trees—including a Weymouth pine, *Pinus Strobus*, 90 feet high, and 7 feet 6 inches in girth at 5 feet up—in the grounds around it. Onwards we sped through the rural village of Harrietfield for a distance of about 9 miles, until we arrived at Glenalmond House, the seat of Mrs Malcolm Patton, where a short time was devoted to viewing the fine specimens of the newer Coniferæ, which thrive particularly well in the locality. Many clumps of Douglas fir were met with growing well in this upland region, and admiration was also expressed at the long stretch of oak trees planted by the late Mr M'Corquodale, which extended for miles on both sides of the road.

During the drive we kept in sight for a considerable time the famous Glenalmond College, a beautiful example of Early English Gothic architecture, which rose grandly on the other side of the valley over a fine screen of sheltering trees. Meeting Mr John M'Lagan, overseer on The Cairnies estates, who acted as our guide, a visit was paid to the Pine Haugh as soon as we reached Glenalmond. It lies on the north bank of the river Almond, and contains a large number of well-grown and beautiful coniferous trees. Among the best of them was a *Pinus monticola* over 70 feet in height, and 5 feet 5 inches in girth at 5 feet up. In this haugh the late Lord-Justice Clerk Patton laid out between two and three acres for the purpose of putting the different varieties of the newer conifers to a competitive trial. The trees are planted in groups, and among others to be found here are *Abies Albertiana*, *A. Menziesii*, *A. grandis*, *A. Douglasii*, and *A. cephalonica*; *Pinus strobus*, *P. Laricio*, *P. austriaca*, *P. Cembra*, *P. montana*, and *P. monticola*. The palm was awarded to the Menzies spruce for luxuriance of growth and the production of the most timber; but *Pinus monticola*, *Abies Albertiana*, *A. Douglasii*, and *A. grandis* were also doing very well in this high locality, at the base of the Grampians. Time, however, did not admit of a very prolonged examination of this interesting spot, for the main body of the excursionists had turned off for The Cairnies at Harrietfield, and did not pursue their way so far as this up the glen.

Crossing the river Almond again at the bridge of Buchanty, at the foot of the wildly romantic Sma' Glen—near the top of which, in the narrow bottom of the rocky defile, stands Ossian's Stone, said to mark the burial-place of the ancient Gaelic poet—the road turns to the left towards The Cairnies estate of Colonel T. M. Harris, and a stop was made at The Cairnies House, the residence of Mrs Malcolm Patton. Here the late Right Hon. George Patton, Lord-Justice Clerk, carried on extensively the planting of the newer Coniferæ for many years previous to his death in 1869, and most of them are growing with a freedom and luxuriance seldom seen in much more favourable localities for tree growth. This particularly applies to the species of conifers from the temperate regions of North-West America. *Abies Albertiana*, *A. concolor*, *A. Douglasii*, *A. grandis*, *A. magnifica*, *A. Menziesii*, *A. nobilis*, *A. Pattoniana*—named after the Lord-Justice Clerk—and many others are all seen in large numbers, and thriving remarkably well.

At The Cairnies the company were hospitably entertained to lunch by Mrs Malcolm Patton, and afterwards spent some time in viewing the sylvan beauties of the policies and the estate in the neighbourhood of the mansion, with which all were very much charmed. Just within the entrance gate nothing could be finer than the noble avenue of the most graceful species of coniferous trees, which led to a conifer-encircled lawn of great beauty, the charming aspect of which is probably unique in any part of Britain.

The Cairnies was one of the earliest homes of the newer Conifers. The late Lord-Justice Clerk, who succeeded to the property in 1831, spared, we are told by Mr Hunter in his *Woods and Forests of Perthshire*, neither trouble nor expense in securing specimens of the rarer varieties, with the view of testing their adaptability to the climate of this country, both as ornamental and as forest trees. He might well be proud of them could he have but looked upon them to-day. In the policies some of the newer conifers are growing with a beauty and luxuriance that rivetted the attention of the visitors. It would be difficult to say which were most praised. The Prince Albert firs were truly splendid. The seeds of this favourite tree were first sent home to this country by Jeffrey, during the first year of his Oregon expedition, on which he started in 1850, and some of the earliest seeds were sown by Mr Patton soon after their arrival in Scotland. Several of the Albert firs at The Cairnies are acknowledged to be among the finest in the country, and there are many noteworthy trees of *Abies concolor*, *A. Douglasii*, *A. grandis*, *A. nobilis*, *A. Menziesii*, *A. Nordmanniana*, *A. Pinsapo; Cupressus Lawsoniana*, *Pinus monticola*, *Thuja gigantea*, *Thujopsis borealis*, and *Wellingtonia gigantea*. The dimensions of some of the best of the conifers are given in the following table, but there are scores of the same trees equally large, and perhaps even larger. As Mr M'Lagan, to whom we were indebted for the measurements, truly remarked, it was not an easy matter to pick out the biggest among so many, and especially when they are growing so thickly crowded together as they are at The Cairnies. The trees measured are all from thirty to thirty-five years of age.

CONIFERS AT THE CAIRNIES.

Botanical Name.	Height.	Girth at 5 feet up.	
	feet.	ft.	ins.
Abies Albertiana, . . .	63	6	9
,, *cephalonica*, . . .	47	5	0
,, *concolor*, . . .	55	6	0
,, *Douglasii*, . . .	61	5	4
,, *grandis*, . . .	61	5	8
,, *Hookeriana*, . .	25	1	6
,, *magnifica*, . . .	50	3	6
,, *Menziesii*, . . .	77	6	8
,, *Morinda*, . . .	35	3	0
,, *nobilis*, . . .	65	5	9
,, *Nordmanniana*, . .	57	4	10
,, *orientalis*, . . .	50	3	3
,, *Pattoniana*, . . .	30	3	0
,, *Pindrow*, . . .	25	3	0
,, *Pinsapo*, . . .	26	3	2
,, *Webbiana*, . . .	36	2	8
Araucaria imbricata, . .	30	2	2
Cupressus Lawsoniana, . .	36	3	4
Pinus Cembra, . . .	45	4	0
,, *monticola*, . . .	70	5	3
Taxodium sempervirens, .	42	3	2
Thuja gigantea, . . .	48	2	6
Wellingtonia gigantea, . .	45	7	2

A great feature of interest was the visit which was paid to the original tree of *Abies Pattoniana*, which was found growing in the corner of the grounds near to the gardens. It was called after Mr Patton, who was a leading member of the Oregon Association, and the tree, needless to say, was inspected with much interest.

Previous to leaving this charming spot, the officials of the Society were received by Mrs Malcolm Patton, to whom Professor Bayley Balfour tendered the thanks of the Society for her great kindness and hospitality. They had all been delighted with the visit which they had paid to her beautiful and romantic grounds.

KEILLOUR AND BALGOWAN.

At this point about one half the company, who had to catch early trains, took carriages direct to Perth. The other half went on to visit the pinetum at Keillour and the estate of Balgowan, belonging to Captain Black, who had in the kindest possible manner driven over to The Cairnies to conduct the party in person over his property.

As we drove across the purple heather-clad moor, it was noticed that much of it had been planted in recent years with larch, Scots fir, and spruce, freely sprinkled with Menzies and Douglas firs, as well as others of the newer Conifers, which were all making satisfactory progress.

A drive of about a couple of miles brought the company to Keillour Pinetum, on the property of Captain Black of Balgowan, where many fine specimens of coniferous trees of all kinds were seen of great size, and growing with remarkable vigour on what, within the memory of men still living, was a cold bleak moor, not worth enclosing for the scanty pasture it afforded.

The pinetum was originally the property of Mr Smythe of Methven, and the trees would be planted about 1834 by the same hand as set out many of those at Methven Castle. The Douglas fir, Menzies spruce, *Abies grandis*, *A. nobilis*, *Pinus monticola*, *Araucaria imbricata*, and many others are doing well in the pinetum, which is about 6 acres in extent. It occupies a position in the centre of a very extensive plantation of spruce, Scots fir, and larch, all doing well, though the moor is black and bleak, and marshy in places, with a cool tilly bottom not generally supposed to be well adapted for growing conifers, especially the rarer varieties. Many of them, however, are not only healthy but luxuriant. The giant of the place was a grand *Abies Menziesii* over 100 feet high, and girthing 14 feet 8 inches at 5 feet from the ground. It was planted in 1834, of which mention is made by Bishop in the Methven Castle records, and is at the present moment probably the finest tree of the kind in the United Kingdom. It was very much admired, clothed as it was with foliage down to the very ground. Near it are Wellingtonias, Redwoods, Deodars, and many other firs and pines, but none of them have attained to the dimensions of this gigantic Menzies spruce. Among the pines, *Pinus monticola* was found to be thriving particularly well, and seems to be one of the best of the North American pines for growing in Scotland. The Deodars and *Pinus Cembra* were not happy looking, the soil being possibly too poor and cold for their tastes.

A very curious and striking variety was seen of the Balsam fir, *Abies balsamea*, from North America. It puzzled the botanists of the company to say exactly what it was, being so different in appearance from the typical form as to seem another species. Professor Bayley Balfour carried off some well-coned branches of it, and these having been forwarded to Dr Masters of the *Gardeners' Chronicle*, one of the recognised authorities on Conifers, he pronounced it to be *Abies balsamea*.

Leaving the pinetum, the party drove at a rapid pace to Captain Black's home nurseries, near Keillour Castle, where was growing a large and healthy stock of young trees—chiefly the rarer conifers raised from seed gathered off the trees in the pinetum. Again the road was taken, and driving rapidly down country, Balgowan, the seat of Captain J. S. Black, and the birthplace of General Lord Lynedoch, the Peninsular warrior, was soon reached, at the bottom of the wide "braes." In the beautiful and well-laid-out grounds around the mansion were seen many fine trees and handsome specimens of the newer Coniferæ, an inspection of which fitly closed what may be called a "Conifer Excursion." It was a misfortune that so short a time could be spent here, where there was so much that was worthy of careful inspection. But time was flying, and the company, in order to see something of the policies, had literally to gallop through them. In the grounds were some grand ancestral trees, and many of the rarer conifers in the most vigorous health and perfect beauty.

Among notable trees which were measured were a Cedar of Lebanon, 12 feet 10 inches in girth; a beech, 11 feet 2 inches; and an oak, 13 feet 9 inches,—all taken at 5 feet up. Splendid examples also were seen of *Abies Albertiana*, *A. Douglasii*, *A. grandis*, *A. nobilis*, *A. Nordmanniana*, *Cupressus Lawsoniana*, *Thuja gigantea*, and *Thujopsis borealis*. The views all around were very beautiful—the rich agricultural country, stretching away from the mansion-house, looking well under the beams of the now declining sun. Before leaving, the company were conducted to the front of the mansion, where, on the smoothly-shaven lawn, there was set out a sumptuous tea, over which Mrs Black presided with charming grace. A quarter of an hour was spent in a most agreeable way, enjoying the hospitality of Captain and Mrs Black, and then adieu had to be said. Professor Bayley Balfour once more gave expression to the gratitude of the company for the kindness they had received in Perthshire on this occasion, and to Captain and Mrs Black tendered the most cordial thanks of the Society. Three cheers having been given for their host and hostess, the company took carriages and started on their way for Perth. Driving rapidly through the village of Methven, and along the road traversed in the morning, the party reached the railway station just in time to catch the last trains going north and south.

It is one of the peculiarities of the excursions of the Royal Scottish Arboricultural Society, that the latest always seems the best. The 1892 excursion takes its place as the best attended the Society has ever held, and in point of interest, it certainly holds its own with those which have preceded it.

Royal Scottish Arboricultural Society.

PROCEEDINGS

OF THE

THIRTY-NINTH ANNUAL GENERAL MEETING

1892.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

The Thirty-Ninth Annual General Meeting of the Royal Scottish Arboricultural Society was held in the Society's Rooms, 5 St Andrew Square, Edinburgh, on the evening of Tuesday the 9th day of August, 1892. The President of the Society, Isaac Bayley Balfour, Esq., M.D., D.Sc., Professor of Botany, Edinburgh University, in the Chair. There was a large attendance of Members from all parts of the country.

Minutes Read.

The Minutes of last Annual General Meeting were read and approved of.

For the information of the Members, the Secretary read the Minutes of the various Council Meetings held during the past year.

Election of New Members.

The Secretary notified the following list of Candidates for Membership, stating at the same time that the number was the largest submitted to the Society for Election since the year of the Forestry Exhibition. The Candidates proposed and duly elected were :—

Adamson, Christopher, Merchant, Leven, Fife.
Aird, Archibald, Assistant Forester, Scone, Perth.
Baillie, Thomas, Assistant Forester, Tomnacroich, Fortingall, Perthshire.
Ballingal, Neil, Sweet Bank, Markinch, Fife.
5 Barty, Rev. Dr, The Manse, Kirkcolm, Stranraer.
Bond, Thomas, Forester, Gartshore Estate, Kilsyth, Stirlingshire.
Chapman, Andrew, Breckonhill, Lockerbie.

Clark, John, jun., Assistant Forester, Haddo House, Aberdeen.
Clark, William, 66 Queen Street, Edinburgh.
10 Cowan, George, 1 Gillsland Road, Edinburgh.
Davidson, John, Forester, Dalzell Farm, Motherwell.
Davidson, William, Assistant Forester, Glamis, Forfarshire.
Dick, Robert, Assistant Forester, Wykeham Abbey, Yorkshire.
Dow, R., Forester, Douglas Castle, Douglas.
Elliot, John, Assistant Forester, Scone, Perth.
Forgan, James, Sunnybraes, Largo, Fife.
Forgan, William, Assistant Forester, Lynedoch, Perth.
Fraser, George, 24 St Andrew Square, Edinburgh.
Fraser, Simon, Forester, Boidon, Luss.
20 Gibson, William, Overseer, Kildonan, Barrhill, Ayrshire.
Hardie, D., Factor, Dalzell Farm, Motherwell.
Hay, John, Overseer, Birchhill Cottage, Clackmannan.
Heron, James, Gardener, Pollok House, Pollokshaws.
Honeyman, Thomas, Factor, Clunes, Auchnacarry.
Kerr, John, Yorkston, Gorebridge.
Kerr, Robert G., St Clement's Wells, Musselburgh.
M'Dowall, James, Gardener, Kildonan, Ayrshire.
M'Kay, Allan, Assistant Forester, Dunrobin, Golspie.
M'Rae, Alexander, Wemyss Saw Mills, Leven, Fife.
30 Macbean, Simon, Forester, Drumnaglass, by Inverness.
MacCowan, Daniel, Assistant Forester, Hornby Castle, Lancaster.
Mackenzie, W. A., Assistant Factor, Strabane, Brodick.
Maclennan, William, Factor, Prestonhall, Dalkeith.
Maxwell, James, Assistant Forester, Bellstane, Drumlanrig, Dumfriesshire.
Methven, John, The Gardens, Blythswood, Renfrewshire.
Milne, J. K., Kevock Tower, Lasswade.
Murdoch, John, Rosemount, Dalkeith.
Murray, Alexander, Forester, Murthly, Perth.
Murray, John, Forester, Airthrey Castle, Bridge of Allan.
40 Pirrie, George, Wood Merchant, Dalkeith.
Potts, G. H., Fettes Mount, Lasswade.
Proudfoot, William, Forester, Raith, Kirkcaldy.
Ramsay, Walter, Assistant Forester, Pollok Estate, Pollokshaws.
Ritchie, Alexander, Assistant Forester, Lynedoch, Perth.
Scott, David, Overseer, Dumfries House, Cumnock.
Scott, John, Forester and Bailiff, Gilling Castle Estate, Yorks.
Smith, Charles, Gardener, Colesbourne Park, Cheltenham, Gloucestershire.
Stewart, Sir Mark J., Bart., M.P., of Southwick, Kirkcudbrightshire.
Sutherland, John D., Estate Agent, Oban.
50 Tait, James, Builder, Penicuik.
Taylor, Alexander, Assistant Forester, Lynedoch, Perth.
Tennant, Edward, The Glen, Innerleithen, Peeblesshire.
Wallace, Robert, Professor of Agriculture, Edinburgh University.
Winton, Thomas, Timber Merchant, Dundee.
55 Young, H. O., Milford Nurseries, Milford, Surrey.

Vote of Sympathy.

Mr M. Dunn moved that the Society send an expression of sympathy to the Marquis and Marchioness of Lothian in connection with the death of Lord Ancram. The Marquis, he said, was a past president of the Society, and took a great interest in all forestry matters. Mr R. D. Ker, W.S., seconded the motion, which was cordially adopted.

Election of Office-Bearers.

The following were elected for Office for year 1892-93:—

PRESIDENT.

Isaac Bayley Balfour, Sc.D., M.D., F.L.S., Professor of Botany, Edinburgh.

VICE-PRESIDENTS.

Hugh Cleghorn, M.D., LL.D., F.R.S.E., of Stravithie, St Andrews.
Wellwood H. Maxwell of Munches, Kirkcudbrightshire.
W. M. Welsh, Nurseryman and Seedsman, 1 Waterloo Place, Edinburgh.
Robert Lindsay, Curator, Royal Botanic Garden, Edinburgh.
John Methven, Nurseryman, 15 Princes Street, Edinburgh.

COUNCIL.

Robert Baxter, Forester, Dalkeith Park, Dalkeith.
Daniel Dewar, Forester, Beaufort, Beauly.
D. F. Mackenzie, Factor, Morton Hall, Liberton.
D. Scott, Wood Manager, Darnaway, Forres.
William Somerville, D.Œc., B.Sc., F.R.S.E., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.
Charles Buchanan, Overseer, Penicuik House, Penicuik.
James Cook, Land Steward, Arniston, Gorebridge.
Robert Hutchison, F.R.S.E., University Club, Edinburgh.
James Kay, Forester, Bute Estate, Rothesay.
James Moffat, Assistant Factor, 48 Castle Street, Edinburgh.
Lewis Bayne, Forester, Scone, Perthshire.
Malcolm Dunn, The Palace Gardens, Dalkeith.
D. P. Laird, Nurseryman, Pinkhill, Murrayfield, Midlothian.
R. C. Munro-Ferguson, M.P., of Raith and Novar.
Andrew Slater, Overseer, Haystoun, Peebles.

SECRETARY AND TREASURER.

William J. Moffat, 5 St Andrew Square, Edinburgh.

AUDITOR.

John Ord Mackenzie, W.S., of Dolphinton, 9 Hill Street, Edinburgh.

JUDGES.

D. SCOTT, Wood Manager, Darnaway, Forres (*Convener*).
D. DEWAR, Forester, Beaufort Castle, Beauly.
JOHN ALLAN, Forester, Dalmeny.
A. MILNE (of Messrs Dickson & Sons), Edinburgh.

COMMITTEE ON TRANSACTIONS.

Dr CLEGHORN of Stravithie, St Andrews (*Convener*).
Professor I. BAYLEY BALFOUR, Edinburgh.
MALCOLM DUNN, The Palace Gardens, Dalkeith.
ROBERT LINDSAY, Curator, Royal Botanic Garden, Edinburgh.
JOHN METHVEN (of Messrs Thomas Methven & Sons), Edinburgh.
WM. SOMERVILLE, Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

PHOTOGRAPHIC ARTIST.

PHILIP COCKBURN, Dalkeith.

LOCAL SECRETARIES.

Scotland.

DANIEL DEWAR, Forester, Beaufort Castle, Beauly.
WILLIAM DOUGHTY, Forester, Langholm Estate, Canonbie.
JOHN FINGLAND, Forester, Drumlanrig, Thornhill, Dumfriesshire.
JAMES KAY, Forester, Bute Estate, Rothesay.
DONALD M'CORQUODALE, Forester, Dunrobin Castle, Golspie.
WILLIAM M'LEAN, Forester, Eglinton Castle, Irvine.
C. Y. MICHIE, Forester, Cullen House, Banffshire.
JOHN MICHIE, Forester, Balmoral, Ballater.
JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
D. SCOTT, Forester, Darnaway Castle, Forres.

England.

JAMES BARTON, Forester, Hatfield, Herts.
JAMES BARRIE, Forester, Stevenstone Estate, Torrington, Devon.
JAMES BELL, The Gardens, Stratfieldsaye, Winchfield, Hants.
ANDREW BOA, junior, Sub-Agent, Great Thurlow, Suffolk.
ROBERT T. COLLINS, Forester, Trentham, Stoke-on-Trent, Staffordshire.
JOHN DAVIDSON, *Secretary*, English Arboricultural Society, Haydon-Bridge-on-Tyne.
J. M. FORSYTHE, Wood Manager, Woburn, Beds.
FRANK HULL, Forester, Lillieshall, Newport, Salop.
JAMES RUTHERFORD, Agent, Kirkleatham, Redcar, Yorkshire.
D. TAIT, Estate Bailiff, Owston Park, Doncaster, Yorks.
A. D. WEBSTER, Hollydale, Keston, Kent.

Ireland.

ROBERT COUPAR, Forester, Ashford, Cong, County Galway.

CHAIRMAN'S ADDRESS.

The President then delivered the Annual Address,[1] in which he reviewed the work done by the Society during the past year, particularly in regard to the Endowment of the Chair of Forestry in the University of Edinburgh. He also spoke at some length upon the development of the scheme he promulgated at the Annual Meeting last year, as to the establishment of a Course of Instruction, whereby practical foresters attending the classes would find regular employment during the curriculum, either in the Royal Botanic Garden, or, through the courtesy of the owners, in the nurseries in or about Edinburgh. He had great pleasure in stating that the scheme was now an assured fact, and looked forward with hopefulness to the commencement of its work at the beginning of the Winter Session.

Mr JOHN METHVEN said,—I am sure you will all agree with me in according to Professor Bayley Balfour a hearty vote of thanks for his interesting address. I can, I think, assure him of the hearty co-operation of my brethren in the nursery trade in carrying out the admirable scheme which he has explained to us this evening. The scheme is in my opinion well adapted to enable young foresters to attain a knowledge of the scientific side of their profession; and, unless they were so equipped, they could hardly be said to be well qualified for the responsible positions which many of them would be called upon to fill in connection with the estates of this country. At the present moment the trained young forester was a very scarce article. Many of you must have noticed, during the past two or three years, the number of advertisements which had appeared for young foresters. One reason for that was the depopulation of the rural districts. Instead of Edinburgh getting men from the country, we have to send a considerable number of men from Edinburgh to the country—men who really had little or no training in wielding the axe and the hedge-bill. I do not see why young gardeners should not be taught something of forestry, and young foresters something of gardening. They are closely related professions; and to me it is one of the recommendations of Professor Balfour's scheme, that the gardener and the forester will be trained and taught together.

Mr DUNN, in seconding the vote of thanks, said,—That to Professor Bayley Balfour is due the credit of being the first to

[1] A verbatim report of the Address appears in the *Transactions*.

formulate a practical scheme for educating young working foresters as well as gardeners, in the science of their profession. It has been talked of for a long time; now we rejoice that it is on the eve of accomplishment. We are all pleased to hear that Mr Methven and the other gentlemen in the nursery trade mean to give their support to Professor Bayley Balfour to make this a really workable and efficient scheme.

Professor Bayley Balfour in reply, said,—I thank you very much for this expression of confidence. I shall ask the Society to help me to circulate further information regarding the scheme as soon as the details are definitely arranged. I should like to say how pleased I am to have confirmation, of what I knew would be the case, that the nurserymen of Edinburgh mean to co-operate in promoting this scheme. With their co-operation, I am sure we shall be able to carry it out to a successful issue. In drawing up this scheme, I have taken the same view that I think most of you take—that the education of the forester and the gardener is fundamentally the same. They are both dealing with the same class of objects, and the cultivation of the one is practically, in so far as the scientific principles are concerned, the cultivation of the other. It is only when you come to the higher branches of culture that the two diverge. It will do both a great amount of good to know something of the work of the other.

The Chair of Forestry.

Dr Somerville—At this late hour I will not detain you by a long statement on this subject. As a matter of fact, very little indeed is necessary. Professor Bayley Balfour has laid before us a very complete scheme for the training of working foresters. We can leave that scheme with confidence in his hands. I would only impress this upon him as very desirable, that the authorities at the Botanic Garden should avoid giving a certificate to any man who has passed through the course, but who is not a thoroughly practical forester. I do not know how Professor Balfour can best keep out those men who have not a knowledge of practical forestry, but I have no doubt he will find some safe way to overcome this difficulty. The teaching which has already been given has even now borne good fruit. They would have seen with pleasure that one of the students who had taken the University Course of Forestry Lectures—Mr A. C. Forbes—had suddenly sprung into the very front rank, having just been appointed head forester on the extensive English and Irish estates of the Marquis of Lansdowne. I think that is an example which may well stimulate other young men to greater efforts in their scientific studies. In regard to the Endowment Fund for a Chair of Forestry in the University, this Society has continued its exertions to some purpose. It has brought the subject before the University Commission, and the Commission has given it a very favourable hearing. Forestry has now found a place among the subjects of study for the Bachelor of Science degree. It is most desirable that any one who takes the B.Sc. degree in Agriculture should have a competent knowledge of Forestry, which is surely a most important department of Rural Economy. I notice in a document issued by the Commission, that there is a specific recommendation that a Chair of Forestry should be established in the University of Edinburgh. Now, we are to have in the Botanic Garden the practical teaching of working foresters; but it is also right that we should have the higher teaching in the University of Edinburgh—teaching that will be more fitted for proprietors, and factors, and lawyers, as also for the young men who have passed through the course of study in the Garden, and who may desire to go on to the University. I cannot conceive of a better way for a proprietor to spend a little of his money than in setting apart for the staff on his estate one scholarship, or bursary, which would enable a deserving young man, who had passed through the Course at the Garden, to crown his training, as it were, by taking a year or more at the University. In various other ways a Chair of Forestry in the University is really a most important thing; and the response which has been made to the application for funds, I consider extremely satisfactory. We have here a list of subscriptions amounting to close on £2000. Now we are aiming at raising £5000; because, counting on the encouragement that Government has already given us, we have every reason to expect that when we raise £5000, Government will add £5000 more. What we still want, therefore, is £2500 or £3000, and surely we may safely count on the patriotism of Scotsmen to raise that sum. It has been suggested that the list of subscriptions should appear in the public prints, accompanied by a statement of the objects which the Society aimed at. I think we have cause for thankfulness that we have every prospect of an early and satisfactory termination to our exertions.

The Hon. Mr Waldegrave-Leslie thought that without much difficulty they might get some of the accumulated funds of the Highland and Agricultural Society. He thought it was quite within the scope of that Society to make such a grant for the endowment of the Chair of Forestry.

Professor BAYLEY BALFOUR said he was sure they would all be glad if they could get hold of some of the accumulated funds Mr Leslie had mentioned; and he trusted Mr Leslie would use his influence with the Highland Society to get it to make a liberal grant.

THE TREASURER'S REPORT.

The TREASURER stated that there was a balance brought forward from last account of £32, 15s. 9d., and that the income for the year 1891, including £98, 3s. 6d. of Annual Subscriptions, amounted to £131, 16s.

These two sums, together with an overdraft from Bank, met the expenditure on Printing, Stationery, Prizes, Office Rent, Salary, Postages, etc., which amounted to £187, 14s. 2d.

The nett funds of the Society amounted to £101, 2s., being the amount at credit of deposit account with National Bank of Scotland, after giving effect to the balance of operations on current account, and adding the cash in hand.

The Council regretted that they had to show a deficit on the business of the year of £55, 18s. 2d., which was, however, to be accounted for wholly by the non-payment of Subscriptions, no less a sum than £58, 16s. 6d. of arrears having had to be written off as irrecoverable.

With the severe purging the roll had thus received, and the large accession this year of new members, it was to be hoped that no deficit would appear in future years.

Mr JAMES COOK, Arniston, Gorebridge, moved the adoption of the Report, which was agreed to.

THE PRIZE ESSAYS AND AWARDS.

Mr ANDREW SLATER, Overseer, Haystoun, Peebles, *Convener* of the Judges, then read their Report on the Essays, and the following Awards were made in accordance therewith,—the sealed envelope accompanying the Essay being opened by the Secretary, and the author's name announced to the meeting.

Report by the Judges on the Essays, etc., sent to the Royal Scottish Arboricultural Society for Competition in 1892.

The Essays and Reports submitted to us for adjudication number thirteen, and although there are none of outstanding merit, they may, on the whole, be considered of an average character.

We would impress upon writers the necessity of basing, as far as possible, whatever they advance on experience and reliable data, so that the papers may be of real practical value, and a trustworthy source for reference.

It would also be desirable, when writing these papers, that the authors should endeavour to compress their ideas into as little space as possible. They would thus save themselves and the editor a considerable amount of trouble, and the judges would doubtless read them with greater favour.

Class I.

The first paper on the list is—

I. On the Preparation of Wood Specimens for Exhibition. By George Cadell, Langley House, Langley Avenue, Surbiton, Surrey.

It is one of considerable interest and merit, and although the author has diverged somewhat from his subject, we consider the foreign matter he has introduced of greater value than that on which it is supposed to treat. We recommend to the author the Award of the No. 1 Silver Medal.

II. On the Present State and Future Prospects of Arboriculture in the County of Perth. By Alexander Pitcaithley, Forester, Sudbourne Hall, Wickham Market, Suffolk.

Owing to the extent and varied character of the woodlands of Perthshire, no better field could well be placed before a writer to obtain material for forming an essay of an interesting and instructive character. The writer has failed to take advantage of this, and we consider that he has not done anything like justice to the subject. We therefore recommend a No. 2 Silver Medal.

III. On Burnham Beeches and fifty of the most remarkable of its Beech Trees. By A. C. Forbes, Bowood, Calne, Wilts.

This paper is accompanied by photographs of a dozen of the most picturesque specimens of these trees, and the reporter gives a number of measurements, and appears to deal pretty fully with the subject. Although it is no fault of the writer of this report, we consider that such papers are of little practical value to the members of this Society, and that the subject of "Old or Remarkable Trees" should be deleted from the Syllabus. A No. 2 Silver Medal is recommended.

IV. On the use of Electric Power in the Forest. By A. T. Williamson, 7 Kew Terrace, Edinburgh.

The author deals with a power that may at some future period be of practical use to the forester. In the meantime we consider that, until its utility in the forest has been fully exemplified, such a paper is premature, and we can only Commend it.

V. On the Island of Arran as a Field for Planting. By W. A. Mackenzie, Strabane, Brodick.

A well-written and descriptive essay on the Arboricultural features of the island. It shows their present condition, and what their future might be were the author's suggestions carried out. A No. 1 Silver Medal is recommended.

VI. On Replanting Open Spaces in Woods. By W. A. Mackenzie, Strabane, Brodick.

So far as it goes, this is a fairly practical and useful report, and we recommend a No. 2 Silver Medal.

VII. On the Afforestation of Large Areas in the Highlands and Islands of Scotland. By W. A. Mackenzie, Strabane, Brodick.

This essay, although of a somewhat theoretical character, is of considerable merit, and we consider the writer entitled to the Medal offered. (Medal presented by William M. Welsh, Esq., of Messrs Dicksons & Co., 1 Waterloo Place, Edinburgh.)

VIII. On the Advantage of Forming Belts of Plantations on Hill Pasture. By A. Simpson, Assistant Forester, Dunrobin, Golspie.

To do justice to this subject, one requires, among other matters, to have a thorough knowledge of soils and the habits of forest trees, and also of those of Live Stock. We cannot help believing that the writer is deficient in some of these, and that his figures are to a certain extent fanciful. He has, however, dealt with the subject in a fairly practical way, and we consider that the merits of the essay will be met by the award of a No. 2 Silver Medal.

IX. On our Timber Supplies from Abroad. By A. T. Williamson, 7 Kew Terrace, Edinburgh.

This subject has been treated by the writer in an interesting and intelligent manner, and if his figures are correct, we consider it a most useful paper. We recommend the award of a No. 1 Silver Medal.

X. An Invention for drawing together Broken Wires in Fences. By Anthony Simpson, Assistant Forester, Dunrobin, Golspie.

The reporter claims to be the sole inventor of this instrument. While we have no reason to doubt this statement, other machines of a somewhat similar nature have been in use for a considerable time. To the inventor a Bronze Medal is recommended.

Class II.

I. On the Renovation of Overgrown Shrubberies. By Robert W. Milne, Assistant Forester, Lynedoch, Perthshire.

This essay is spoilt by its inordinate length, and the indiscriminate catalogue of plants it contains, many of which are unfit for shrubberies in this country. The writer seems to have a good knowledge of the names of plants, but little experience as to where or how they should be allocated. He is deserving of encouragement, but we regret that we can only recommend a Bronze Medal.

II. On the Management of a Home Nursery. By John Scrimgeour, Assistant Forester, Lynedoch, Perth.

This paper, for its class, is practical and well put together, and we recommend the award of the No. 2 Silver Medal.

III. On the Formation and Management of Live Fences. By A. Simpson, Assistant Forester, Dunrobin, Golspie.

The writer of this paper has dealt in a simple way with his subject, and no exception can be taken to the details he gives, provided they are adapted to local circumstances. A Bronze Medal is recommended.

Edinburgh, *August* 5, 1892.

Mr Dunn, Dalkeith, moved a vote of thanks to the Judges, which was heartily accorded.

Presentations to the Society's Library and Museum.

1. *Transactions of the Massachusetts Horticultural Society*, part 2, 1890.
2. *Transactions of the Massachusetts Horticultural Society*, part 1, 1891.
3. *Bulletin from the Department of Agriculture, Victoria, December* 1890.
4. *Annual Report of the Secretary for Agriculture, Nova Scotia*, 1891.
5. *Annual Report of the Agricultural Research Association*, 1891.
6. *Transactions of the Botanical Society, Edinburgh*, 1891.
7. *A Collection of Wood Specimens from the Forests of Ceylon, by* Mr John Alexander, Forest Department, Ceylon.

Arrangements for Excursion in 1893.

Mr Dunn, Dalkeith, said a number of places had been mentioned to the Council for the Excursion of 1893. It had been suggested, for example, that the Excursion should be to the New Forest, Hants, and that Her Majesty might be asked graciously to grant them permission to inspect Windsor Forest. That at present was a very popular idea. It had also been mooted that they might pay a visit to Ireland; and there were yet many parts of Scotland to explore—in Lanarkshire, Ayrshire, Stirlingshire, Aberdeenshire, and Strathspey. He asked a remit, as usual, to the Council to make the arrangements. After a short discussion the suggestions were approved, and the remit agreed to.

A hearty vote of thanks to the President for occupying the chair brought the meeting to a close.

In Council.

Members are invited to read short practical papers on any subject connected with Forestry at the Annual General Meeting. Those who intend to do so are requested to intimate, in writing, the Title of their subject to the Secretary, on or before the 10th of June 1893; stating the time they may require for reading the paper.

The following subjects are offered for competition in 1893 :—

[*The Judges are empowered to fix the value of the Prizes to be awarded according to the respective merits of the Essays.*

All Essays and Reports intended for Competition must be lodged with the Secretary not later than 10th June 1893, and all Collections of Cones, Seeds, and Rustic Work, not less than three days before the Annual Meeting. Each Essay, Report, Collection, or Article must bear a MOTTO, *and be accompanied by a sealed envelope bearing outside the* SAME MOTTO, *and the Class to which the Competitor belongs, and containing inside, a* CARD *with the* NAME *and* ADDRESS *of the Competitor.*

Judges cannot compete during their term of office.

Successful Competitors may either have the medals or their converted values, which are as follows:—Gold, £5; No. 1 *Silver Medal,* £3; No. 2 *Silver, £2*; *Bronze,* 10s.]

CLASS I.—FOR OPEN COMPETITION.

I. For an approved Report showing the Financial Results of the Cultivation of Woods and Plantations. (*Five Guineas* offered by the President of the Society, Isaac Bayley Balfour, M.D., D.Sc., Professor of Botany in the University of Edinburgh.)

It is not necessary that the names of the estates on which the woods grow should be published, but the reporter must give the annual value of the land previous to planting; statistics of the cost of forming the plantations, including draining and fencing; the expenses of management, the income derived, and the present value of the Woods.

II. For an approved Report detailing the methods employed to bring about the Natural Regeneration of a Wood, and the subsequent Treatment as regards Artificial Assistance, should such have been rendered necessary owing to the Natural Sowing having been irregular, insufficient, or too dense. (*Five Guineas* offered by Alexander Mackenzie, Esq., Superintendent, Epping Forest, Essex.)

The author must cite some particular case, and give the results of a systematic attempt at natural regeneration, bearing in mind the fact that a patchy imperfect restocking cannot be regarded as satisfactory or successful.

IV. For an approved Essay on Pruning of Trees, alike from a Sylvicultural and an Arboricultural point of view; describing in detail the principles that should guide the practice, the methods to be followed in the practice, the effects produced, and the results to be aimed at. (*Five Guineas* offered by the President of the Society, Isaac Bayley Balfour, M.D., D.Sc., Professor of Botany, Edinburgh University.)

Note.—Both Coniferous and Dicotyledonous trees must be dealt with in the Essay, but the pruning of fruit trees is excluded.

V. For an approved Essay on the best methods of Pruning Avenue and Park Trees, keeping in view the production of timber and the landscape effect; also on the best methods for renovating old Park Trees. (*Silver Medal* offered by Wm. M. Welsh, Esq., of Messrs Dicksons & Co., 1 Waterloo Place, Edinburgh.)

VI. For an approved Essay on the advantages of forming Belts of Plantations on Hill Pasture Land. (*Three Guineas or Medal* offered by John Methven, Esq., Leith Walk Nurseries, Edinburgh.)

The author to give details of the best method of laying out the plantations, their proper width, the best system of draining and fencing, and the most suitable varieties of trees to be grown.

VII. For an approved Report on the Newer Coniferæ growing in any County in Scotland. (*A Medal.*)

The Report to give the age, height, and girth of stem at 5 feet up, of the best trees of each species; the diameter of spread of branches of ornamental specimens; the altitude, aspect, and exposure, and the nature of the soil and subsoil where they grow. Details should be given of any special merit or feature displayed in their habit and rate of growth, and of their qualities and uses for economic or ornamental purposes.

VIII. For an approved Essay on the Valuation of Woods or Plantations for the purpose of Transfer. (*A Medal.*)

The writer to describe the method (*a*) of valuing matured woods, (*b*) middle-aged woods, (*c*) park trees and others that may be, in addition to their value as timber, considered as ornamental, (*d*) young woods, and (*e*) coppice.

IX. For an approved Report on the Plantations of which the competitor is Forester. Reporter to state the extent of plantations, the kinds of timber grown, soil, situation, age, management, etc. This is a standing subject. (*A Medal.*)

X. For an approved Report on the Present State and Future Prospects of Arboriculture in the County of Fife. (*A Medal.*)

XI. For an approved Report on the Present State and Future Prospects of Arboriculture in the County of Inverness. (*A Medal.*)

Note.—The Council desire it to be understood with reference to subjects VI. and VII., that the Counties will be changed annually.

XII. On the best Method of Procedure in growing a continuous Crop of Timber in Woods or Plantations. (*A Medal.*)

The Essay should deal with the different kinds of Woods, the ages, and proportion per acre of the trees at different stages, and whether these have been raised by natural or artificial means. Reference may be made to any system practised abroad which might prove applicable in this country.

XIII. For an approved Essay on the best method of Rearing Plantations with the view of obtaining timber of a clean growth, fine quality, and high commercial value. (*A Medal.*)

The author must keep in mind the necessity of raising timber to successfully compete with the best quality of that imported from abroad.

XIV. For an approved Essay on the Recropping of Land with trees of the same Species. (*A Medal.*)

Special reference must be made to the growing of Larch after Larch, and the reporter should cite examples, describe their altitude and exposure, as well as the character of the soil, and also the time that elapsed after clearing before replanting took place.

XV. For an approved Essay on the best method of Afforesting Bog Land, and the most suitable varieties of Trees with which to plant the same. (*A Medal.*)

XVI. For an approved Essay on the best system of managing Coppice. (*A Medal.*)

XVII. For an approved Essay on the Thinning of Woods, viz.—Close *versus* Wide Thinning; the advantage of the one over the other as regards growth and quality of timber. (*A Medal.*)

XVIII. For the best Collection of the Wood Sections of British grown Trees and Shrubs, properly mounted for the Microscopical examination of the cells, medullary rays, etc. The Sections must be prepared and mounted by the competitor. (*A Medal.*)

XIX. For an approved Essay on the best method of Preventing the Inroads of the Pine Saw-fly—*Lophyrus pini* of Curtis. (*A Medal.*)

XX. For an approved Report on the most advantageous methods, not generally practised in this country, of Transporting Timber. (*A Medal.*)

The reporter specially to describe any means, other than by horse-power, of moving felled timber from the interior of woods to their margins, or to roads.

XXI. For an approved Essay on any Disease incidental to Forest Trees. A standing subject. (*A Medal.*)

XXII. For an approved Report from personal observation on the Management of Forests in any other country than Britain. (*A Medal.*)

Special reference to be made to appliances, modes of culture, and treatment not generally practised in this country.

XXIII. For an approved Essay on the best methods of utilising Small-wood in the manufacture of Fancy-wood articles, Turnery, Wood Wool, etc. (*A Medal.*)

XXIV. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XXV. For an instrument or method for expeditiously obtaining the diameter of trees at a given height, or for any other useful invention or marked improvement on any of the implements used in Forestry. Models or implements to be accompanied by a report. (*A Medal.*)

Class II.—For Assistant Foresters only.

I. For an approved Essay on the Rearing of Natural and Artificial Undercover for Game, and the best methods of encouraging and regulating their growth. (*A Medal.*)

II. For an approved Report, based on personal observation, on the Management of a Home Nursery. (*A Medal.*)

III. For an approved Essay on the best size of Plants, and Method of Planting, to produce the best results in different Soils and Situations. (*A Medal.*)

IV. For an approved Essay on the best methods of Forming and Maintaining Fences. (*A Medal.*)

The writer to give details of the rearing and management of Live and Dead Fences, with the cost, and the comparative value of each, taking into consideration economy, efficiency, and durability.

V. For an approved Essay on the Peeling and Harvesting of different kinds of British Bark used in Tanning. (*A Medal.*)

VI. For an approved Essay on the best method of protecting Trees from injury by Ground Game. (*A Medal.*)

VII. For an approved Essay on Pruning of Forest Trees. (*A Medal.*)

VIII. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

IX. For the best and approved Model in Rustic, or Ornamental Woodwork, of any subject designed and executed by the competitor. Model not to exceed six feet in length. (*A Medal.*)

The Council invite the attention of young Foresters to the foregoing subjects, as they are desirous to encourage their efforts.

Illustrations Fund.

The Council beg to direct special attention to this Fund, the object of which is to obtain contributions to defray the expense of illustrating the Society's *Transactions.*

The following donations have been received from time to time :—

Dr Cleghorn of Stravithie,	£3	10	0
Do., additional,	2	0	0
Do., do. (1890),	1	0	0
Mr D. F. Mackenzie, Morton Hall,	2	0	0
Do., additional (1890),	0	10	0
Mr Malcolm Dunn, Dalkeith,	1	1	0
Do., additional (1890),	1	1	0
Sir Dietrich Brandis (1891),	5	5	0

The Society's Album.

The Council wish it to be known that the Society has an Album for the Photographs of Members, and the Secretary will be glad to receive contributions.

W. J. MOFFAT,
Secretary and Treasurer.